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THE THEORY OF A GLACIAL DAM AT CINCINNATI AND ITS VERIFICATION.

BY PROFESSOR G. FREDERICK WRIGHT.

IN prosecuting investigations upon the boundary of the glaciated area in the Ohio valley, one of the most interesting facts brought to light is, that the true glacial drift is found on the Kentucky hills a few miles south of the Ohio, opposite Cincinnati. Granitic boulders, striated pebbles, and till are found all over Brown and Clermont counties, in Ohio, down to the margin of the Ohio river, where they cease. Nothing of the sort is found on the hills in Bracken county, Ky. But on crossing the river from New Richmond in Clermont county, Ohio, to a point in Kentucky near the boundary of Kenton and Campbell counties, glacial drift at once reappears upon the south side of the river at about an elevation of three hundred or four hundred feet, covering the hills for two or three miles back from the river. Till several feet deep here occurs, containing numerous granitic pebbles and small boulders and excellent specimens of striated stones, whose native place is not far north in Ohio.

I did not personally go over the hills in the northern part of Campbell county, but did explore Northern Kenton and Boone counties with considerable minuteness, and found glacial deposits extensive over the northern part of Boone county as far south as Burlington. About three miles east of Burlington, on the road to Florence, there is, for instance, a notable collection of boulders, of which I counted fifteen or twenty in the space of a few yards. These are in a shallow valley of Gunpowder creek, a small stream entering the Ohio near the southern part of the county. This clus-

ter of boulders was by my barometer 450 feet above the river, and the water-shed was at least a hundred feet higher. Two of the boulders are veritable specimens of the jasper conglomerate, so abundant about the outlet of Lake Superior. Granitic boulders and striated pebbles were also found at numerous other points over the northern part of Boone county, from Greenwood lake to Bellevue. Glacial accumulations also occur upon all points of the river north of this down to the river valley. It thus appears that from Moscow, in Clermont county, about twenty-five miles above Cincinnati, to Petersburg, Ky., about the same distance below Cincinnati, that is, for a distance of about fifty miles, the valley of the Ohio was for a short time during the glacial period filled with ice, forming an obstruction to the water at least 550 feet high. The water shed to the west, between the Licking and the Ohio, is nowhere less than this height. Walton station, seventeen miles south and a little to the west of the water-shed, is 473 feet above the river, 913 feet above the sea.

Throughout nearly its whole extent the Ohio river occupies a narrow valley of erosion less than a mile in width, and from three hundred to five hundred feet in depth. There are enlargements in this trough wherever tributaries come in, either from the north or from the south, which also uniformly occupy valleys of erosion of corresponding depth, the width varying according to the size of the stream.

It is evident that during the continuance of this supposed glacial dam at Cincinnati, a narrow lake corresponding in depth to the ice-barrier, must have extended far up the Ohio and all its tributaries; among which may be specially noted the Licking in Kentucky, the Kanawha in West Virginia, the Allegheny and Monongahela in Pennsylvania. The difference between the levels of Pittsburgh and Cincinnati is about three hundred feet; so that a barrier of six hundred feet at Cincinnati would submerge the city of Pittsburgh to a depth of about three hundred feet.

It is also evident that if there was, for any considerable period, such a glacial back-water dam as is supposed, there ought to be some evidence of it in the shape of terraces marking the old lake margin. Such evidence was not long in coming to hand, and it is all the more significant because furnished by independent parties. In March, 1883, I read a paper before the Boston Society of Natural History in which I reported the main facts just recounted.

Upon seeing this report, Professor I. C. White, of Morgantown, West Va., situated in the Monongahela valley, and who has for many years been an active member of the Pennsylvania Geological Survey, informed me that the ice dam at Cincinnati was exactly what was needed to explain the terraces along the Monongahela. It appears that from Pittsburgh as far south as Fairmount, in West Virginia, a distance of 130 miles (which was as far south as Professor White had examined), the valley of the Monongahela shows signs along its edges of having been partially silted up with heaps of trash, such as clay, sand, gravel, boulders, drifted logs and other rubbish, brought in by its tributaries from higher land. The striking peculiarity of these terrace deposits is, that they "suddenly disappear at an elevation of 1050 or 1075 feet above tide; not a single rounded and transported boulder ever being found above that latter horizon, though occuring in countless numbers below this level. The hills above the river often rise three hundred or four hundred feet higher than the upper limits of the deposits, so that there can be no mistake about the elevation at which the terrace deposits disappear. * * Back from the channel of the river, especially where the surface configuration would make quiet water, there occur thick deposits of very fine, bluish-white clay in which great numbers of leaves are most beautifully preserved. This deposit is purest near the upper limits of the terraces.

"In the vicinity of Morgantown terraces of transported material occur at the following approximate (measured by barometer) elevations:

	Feet above river.	Feet above tide.
First terrace	30	820
Second terrace	75	865
Third terrace	175	965
Fourth terrace	200	990
Fifth terrace	275	1065."

The deposits of the fifth terrace in this series are frequently found far inland from the Monongahela on the tributary streams. In such a deposit near Morgantown, called the Flats, and covering three or four square miles, wells have been sunk sixty-five feet without striking bed rock. This is 275 feet above the river and 1065 feet above tide.

Other tributaries of the Monongahela, along which Professor White "has noted the clay and other deposits of the fifth terrace,

are Decker, Dunkard, Whitely, Muddy and Ten Mile creeks, and in each case the deposits disappear at the same absolute level at which they cease along the river."

Professor Lesley informs us also that the terraces along the Allegheny and its tributaries, preserve this same absolute level.

Coming down to the Great Kanawha river, another branch of the Ohio, which drains an unglaciated region, Professor White finds water-worn boulder deposits disappearing at an elevation of from two hundred to three hundred feet above the present level of the stream. About fifteen miles below Charleston, West Va., there is a deserted river channel followed by the Chesapeake and Ohio railroad, which extends through Putnam and Cabell counties to the mouth of the Guyandotte, at Huntington. This deserted valley is from one to two miles wide, is two hundred or more feet above the Kanawha, and "is filled to a great depth with rounded boulders of sandstone, chert, cannel coal and other trash, which has plainly been transported down the Kanawha from above Charleston, so that it was clearly seen that the water of the Kanawha had once found an outlet to the Ohio by way of this valley," a distance of fifty miles.

During the summer of 1883, I explored a similar deserted channel a little ways further down the river, in Greenup county, Ky. This valley extends from near the mouth of the Big Sandy to Greenupsburg, a distance of about twenty miles, and is from one to two miles wide, is 220 feet above the present high-water mark of the river, running parallel with it and about two miles distant. This, like all the valleys in this region, is a valley of erosion, the hills rising on either side from two hundred to three hundred feet, and the bottom of it is covered with rounded pebbles of quartz and quartzite, from an inch to two feet in diameter.

Coming to the Licking river, in Kentucky, Mr. G. H. Squier informs me that near Owingsville, Bath county, in the angle between Slate creek and the East Fork of Licking, there is an extensive low tableland which is covered by erratics, including numerous water-worn fragments of sandstone and coal, which must have been brought down from the coal fields twenty miles or more to the north-east, and could not have been scattered around as they are over this immediate tableland and the low hills adjoining it, except there had been an extensive body of still water occupying the area. This is just what would have been produced

by the glacial dam which I have supposed to have existed at Cincinnati. The facts had so impressed Mr. Squier that before knowing of my discoveries he had come to the conclusion that there must have been some such barrier as I have supposed. (See *Science*, Sept. 28, 1883.)

Strong as these confirmations are, it is important that the hypothesis of an ice dam should be verified by much wider observations in the field. All along the Ohio river, and in all its tributaries above Cincinnati, there should be found numerous facts, explicable only by this theory; while the absence of terraces of a corresponding level upon the eastern side of the Alleghenies, to which Professor Lesley has called attention, excludes the hypothesis that these high terraces in the Upper Ohio are due to a general Champlain subsidence.

Nor must the phenomena below Cincinnati be overlooked. During the summer of 1883, I continued my investigations into Southern Indiana to the Illinois line in Posey county. But I will not here speak in detail of the results attained. The problem of determining the southern limit of the glaciated area of this region, however, has been complicated by what I supposed to be the results of the Champlain subsidence, amounting to five hundred feet or more in the Mississippi valley. Here, for the first time in my western investigations, I have encountered the loess overlapping and intermingling with the terminal deposits of the glaciated area in a very interesting and puzzling manner. I hope during another summer to get additional light upon the subject. Meanwhile, I am anxious to obtain any information or instruction which the experience or wisdom of other investigators may be able to furnish me.

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THE STRUCTURE OF THE TRACHEÆ OF INSECTS.

BY PROFESSOR G. MACLOSKIE, D.SC., LL.D.

1. *Historical.*—Blanchard's theory of two tracheal membranes with an interposed spiral thread, and of peritracheal circulation, though it was accepted by Louis Agassiz and some other authorities, may be set aside as obsolete. It was well refuted by Joly; and Claparède, in refuting its author's cognate theory of a complex

vascular system in spiders, showed that in both groups the circulation is essentially lacunar.[1]

Recent investigation has established the doctrine that the tracheæ and also the trachea-like salivary ducts are chitinous products of ingrowing processes of the epidermis. Bütschli deems them segmental paired invaginations of the epidermis, while Weismann finds that the tracheal wall is an intima secreted by ingrowing rows of cells, just as the chitinous cuticle is secreted by epidermal cells.[2] These discoveries are of fundamental importance, and must underlie the true theory of the nature of tracheal structures.

The views of some other investigators seem to me not so well established. Meyer, for example, finding that the intima (the name here used to designate the chitinous wall of the trachea) arises as a homogeneous membrane, holds that it subsequently splits so as to give off a spiral thread, and that the larger trunks have a double membrane external to the spiral.[3] Carl Chun supposes that the spiral thread is a true chitine layer, and not merely a thickening product of the intima, and superadds a splitting of the intima into a double membrane.[4] C. S. Minot represents the spiral filaments as solid threads imbedded in the substance of the chitinous intima, and adds some good observations as to the spiral threads (sometimes two to five or six together) ending after a few turns round the trachea, "the single threads terminate not abruptly but by tapering down to a point and so disappearing."[5] None of these observers seem to see, much less to grapple with the difficulty of conceiving how the spiral filament or anything else can be formed external (morphologically) to the chitinous secretion of the epidermis, or how such chitinous outgrowths can split after they are once formed.

2. *Pseudotracheæ of Muscidæ.*—In examining the proboscis of

[1] Blanchard in *Ann. d. Sci. Nat.*, Ser. 3, Vol. IX (1848), and *Ann. and Mag. Nat. Hist.*, Ser. 1, Vol. XX. Joly in *Ann. d. Sci. Nat.*, Ser. 3, Vol. XII (1849). L. Agassiz in Proc. Amer. Ass. Adv. Sci., 1850. Claparède in *Ann. d. Sci. Nat.*, Ser. 5, Vol. II (1864).

[2] *Zeit. f. Wiss. Zool.*, XIII, XIV, XVI (1863–1866, Weismann), XX (1870. Bütschli).

[3] *Zeit. f. Wiss. Zool.*, I (1848).

[4] Inaugural dissert., "U. d. Bau u. der Rectaldrüsen b. d. Insekten," Frankfurt, 1876.

[5] U. S. Entomol. Comm. on Locusts, Report II, p. 192 (1880), and *Recherches histologiques sur les trachées de l'Hydrophilus piceus*, in Archiv. de Physiol. Expt. 1876.

the housefly, some years ago, I made a discovery, the important bearings of which were easy to appreciate; but I did not refer to it in the paper then issued, as I wished to test it more fully. I found that the scraping-tubes (pseudotracheæ) of this organ are flanked by chitinous thickenings of the cuticle, that these thickenings are enfolded or wrinkled so as to resemble the C-like semitubes which serve as an inner skeleton for the pseudotracheæ. The enfolded parts can be flattened out with the needle, and when liberated they at once spring back to their normal crenulated condition (Fig. 1, C). This suggests that the *pseudotracheæ* (P) *are likewise thickened crenulations* of the chitinous membrane with which they are continuous.[1]

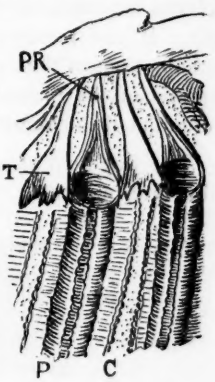

FIG. 1.—From distiproboscis of housefly (*Musca domestica*). P, two pseudotracheæ, with (C) bordering crenulations, and (T) two teeth, PR, basal roots of two pseudotracheæ, inserted in a transverse bar.

This doctrine receives unexpected support from Kraepelin's elaborate paper, just published, on the proboscis of Musca.[2] Kraepelin accepts the views published by myself, and confirmed by Dimmock, as to the general structure of the proboscis, at the same time adding largely to our knowledge of the anatomy of its parts. He also adopts the explanation of its protrusion by the injection of air. He has made the curious discovery that the teeth (T) planted between the roots of the pseudotracheæ, and likewise that these roots themselves, are formed by secondary foldings of the membrane. If he had followed out this observation he would have come to the conclusion that the entire pseudotracheæ, being crenulatious at the outset, are so throughout. This is the conclusion that I formerly reached, as stated above, from an independent line of investigation, and hence I may take it as proven that these structures, so long a subject of interest, have now found their true explanation.

[1] For a description of these parts see my paper on the "Proboscis of the Housefly," AMER. NATURALIST, 1880, p. 153.

[2] Karl Kraepelin, Hamburg. "Zur Anatomie u. Physiol. des Rüssels von Musca," with 2 plates (1883). His figure has three rows of 2-cusped teeth, and probably is drawn from the blowfly (*M. vomitaria*), whilst mine is from the housefly, which has only one or two rows of 3-cusped teeth.

3. Wall of Tracheæ.—This discovery leads to wider results. The pseudotracheæ so closely resemble the salivary duct and the proper tracheæ that all these structures have been frequently confounded together. The pseudotracheæ being surface-productions are open externally by a longitudinal slit. The salivary duct and proper tracheæ, being internal structures, do not admit of a lateral fissure, but they are ingrowths from the surface, and are morphologically of the same nature as the pseudotracheæ. Hence we may expect them to be produced on the same principle. If the pseudotracheæ are demonstrated to be thickened crenulations of the external cuticle, we are led to ask whether the spirals of the proper tracheæ and of the salivary duct are not crenulated thickenings of the intima.

The fragment of a trachea of a centipede (Fig. 2) bears out this interpretation. Above A is a rent with a small fragment of the membrane supporting relics of spirals, which are probably crenulations of the membrane, gradually losing themselves below. This is very unlike what would appear if the spirals were independent structures. Whenever the spiral separates from the membrane the separation is artificial, as the membrane is easily rent. We never find here what is common in plants, the spiral unrolling with the membrane remaining intact. In fact, membrane and spiral here appear to be continuations of each other, the membrane thickening and turning in to form a fold, somewhat after the pattern of the bellows of an accordeon. Minot's observations about the spirals often coming away, several together, and about their tapering down to a point and gradually disappearing, find their explanation in this. At the origin of branches (Fig. 2) the arrangement of the spirals agrees with this view rather than with the supposition of independent threads, and is identical with the pattern of branching at the "catch-drain" of the pseudotracheæ, which we have shown to be crenulations.

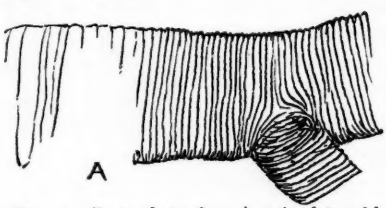

FIG. 2.—Part of trachea (centipede) with origin of branch.

A result of this explanation is, that the spirals themselves are fine tubules, externally opening by a fissure along their course.

They are so minute that we need not be surprised if direct observation has hitherto failed to detect this structure. A cross section of them in my possession (prepared by W. M. Rankin) seems to me to confirm this view; but the outside diameter of the spiral is only .0025^{mm} (about a twenty-thousandth of an inch), and interferences by diffraction lessen the value of direct observations except as to general outline.[1] I think that I can also see evidence of a lumen within the spiral, and of the fissure, in stained specimens of tracheæ prepared in the usual way.[2] Carl Chun's figure, though not so understood by its author, is in accordance with our view (Fig. 3). What he supposes to be solid fibers cannot arise in the way suggested by him, inside and independently of the intima, which is really the boundary of the insect's body. The connecting membrane (M) after reaching the spiral (which is probably hollow) bends in, becoming in fact the wall of the spiral, and on returning to the surface beyond the fissure, is continued as a connecting membrane to the next spiral. What he regards as a superficial ridge on the spirals is here supposed to be the optical expression of the external fissure. I think I have also got the explanation of the "outer membrane of later origin" represented at M^2. It is the first appearance of a new intima prepared to replace the functioning one after the process of molting.

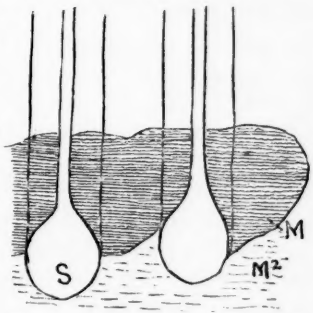

FIG. 3.—Cross-section of two spirals (S) from larva of Eristalis. M, a fragment of connecting membrane; M^2, outer membrane of later origin. After Chun.

The mode of genesis of the spirals has been found by different observers to be first by the formation of homogeneous membrane. This condition persists in fine branches and also in large air-sacs (in these, however, striation is usual). The homogeneous membrane soon becomes transversely striated by incipient crenulation. In a larva we can easily see new tracheæ in the striated condition

[1] The margin of what I take to be their lumen appears to me too sharp to be explained by refraction in solid fibrils.

[2] In stained specimens viewed, as Fig. A, the circle of light at the margin of the spirals is so bright and well defined as to indicate an inner cavity.

enclosing older ones with well-developed spirals; a tube inside of a tube, the contrast between striæ and spirals indicating the course by which increasing crenulation with thickening is turning the smooth membranous tube into the definitely strengthened trachea.

4. Mode of Aëration.—The chitinous walls of the tracheæ are supposed to permit the transmission of air to the surrounding blood, but not the passage of fluids. If we bear in remembrance that the air within them is dry (*sc.*, not dissolved in any fluid), I suspect that the direct passage through the wall is imaginary. Gegenbaur thinks that the fine extremities of the tracheæ may play some part in the function of aëration, and a consideration of the terminals of the tracheal branchlets may well make us ask if they do not perform the chief part. Boudelot has fixed the seat of the respiratory movements in the abdominal nerves, and therefore in the abdominal muscular movements.[1] As the abdomen expands and contracts, the tracheal trunks rhythmically enlarge and diminish, causing inspirations and expirations of air; a partial vacuum and pressure being alternately produced around the trunks. The structure of the spirals indicated above explains what was long a mystery to me, how chitine, which is flexible but not tensile, can secure the enlargement and reduction of volume essential to a tidal movement of air. The opening and closing of the spiral crenulations, with widening and narrowing of the external fissures, respond to the oscillations of pressure, and hence the variations of volume and the movements of air.

The air reaching the numerous branchlets of the tracheæ, supplies directly all the important tissues, the digestive canal, glands, nerves, limbs, eyes, mouth-parts, &c. The branches have no chitine at their extremities, enter directly into what L. Agassiz described (*loc. cit.*) as "bags, which when highly magnified look like small lungs; the branchlets losing the spiral thread when they enter these lungs." Weismann describes and figures these terminals as long spindle-cells having a fine elastic inti na within them; and states that in the young larva they are filled with air. Max Schultze has shown how in the glow-worm (*Lampyris splendidula*) the terminal cells of the tracheæ are stellate, and are abundant at the fat-bodies which by a process of slow combustion

[1] *Ann. d. Sci. Nat.*, Ser. 5, Vol. II (1864).

cause luminosity (Fig. 4). It may be pertinent to cite Quatrefages' description of the luminosity of some marine animals.[1] I have observed that the light flashes in jets along the somites of these worms as if the segmental organs had something to do with its production and with the function of respiration. I have also shown that in the housefly the air-cells in the proboscis expand at each act of respiration.[2] It would thus appear that during inspiration the air is driven into the tracheal end-cells, as into the chambers of our own lungs, and that in this way the tissues are directly aërated. The slower process of aëration by the intervention of the blood may suffice in some larvæ, as in Crustacea, but the chief function of the blood of insects seems to be the conduction of food from the intestinal walls to the various organs.

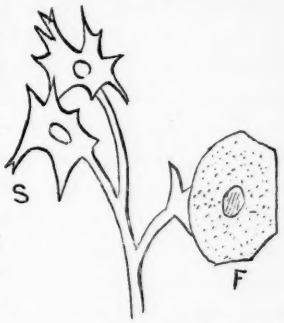

FIG. 4.—Stellate terminals (S) of tracheæ; F, luminous fat cells. After Schultze.

To sum up. The tracheæ of insects and similar organs are supported by chitinous fibers which are crenulations accompanied by thickening of the chitinous intima with which they remain continuous; their dorsal fissure and flexibility providing for the enlargement and reduction of the cavity; and the oxygenation of the tissues has its seat chiefly at the extremity of the tracheal branches, and not by diffusion from the tracheal trunks into the blood.

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AGRICULTURAL BOTANY.

BY E. LEWIS STURTEVANT, M.D.

THE secret of classification consists in the understanding of the motive, of which form and structure are exponents. The natural motive of plants is to secure existence and perpetuation, and parts and habits are and have been so formulated as to compass this object as against difficulties of very varied character. Each individual plant is in a state of unstable equilibrium, ever

[1] *Ann. d. Sci. Nat.*, Vol. XIX (1843).
[2] *Psyche*, No. 100 (Aug., 1882).

tending in the direction of least resistance, and so modifying its own nature as to become better fitted to meet such resistances as cannot be avoided. Each change is subject to transmissal through heredity, and thus through successive accretions, "Holding the gain and answering for the loss" plants become so differentiated as to react favorably with their environment, and in the course of time most numerous forms are established, each expressing the common motive in changes designed to meet a complex environment in which the various factors are of greater or less dominancy. The necessity for a constant struggle for perpetuation, as nature's law is, has made the reproductive organs paramount as expressing the method in which the plant-motive has been fulfilled, and hence the reproductive organs are dominant with the botanist for the purposes of classification, and the beautiful natural system of botany has become recognized as a science.

We have, however, a class of plants in which another motive than that of survival has become dominant, and in which the reproductive organs have become subservient, and this because under the protection and guidance of man, the necessity for the struggle for existence has been removed, and the plant has been left free to respond to new motives which have been impressed upon it. Our domesticated plants exist for man's service, not for their own, and accordingly such have developed away from nature's requirements towards man's requirements. The removing from a plant the necessity of warfare, and the substituting the conditions of peace and plenty, modifies such plant to some degree, but when in addition the motive is brought to harmonize with the desires of man by means of the process of selection, plants become profoundly modified in form and habit, and a parallelism of form is obtained which well illustrates the dominancy of the new motive. Thus the wild cabbage has furnished various divergent forms, and these forms in themselves resemble other forms which occur in plants of different species, genera and even natural orders. We have parallelism of form between varieties of the kale and parsley (dwarf curled kale and early cut-leaved parsley), the cabbage, lettuce, chicory, etc. (Tourlaville cabbage, cabbage-lettuce, scarole en cornet), the cabbage and the chard-beet (Pak-choi cabbage, white-leaf beet) according as the motive has been for leaf, head or stalk. This parallelism is to be seen in various others of our domesticated vegetables.

Just as the dominant motives in nature have secured fixity for types, so the dominant motives under art have secured fixity of type, but as the motives differ, so do the types differ. Hence natural botany cannot serve to secure classification for plants which have become domesticated, and for these latter we require a new botany, which we may call agricultural botany, and which must be devised alike in its principles with natural botany, but divergent in its methods of application in accordance with the divergent plant-motives.

In agricultural botany as in the natural botany, heredity must be considered in arrangement, for a true classification must deal with the totality of plant structure, form and motives, yet while in natural botany the reproductive organs, the expression of the paramount motive given to the plant by nature, must be considered paramount for the purposes of classification, in agricultural botany form must be considered as paramount as representing the paramount motive supplied to the plant by man. In the natural botany, species, genera, orders and classes represent stages in the development under nature, in the agricultural botany successive changes in selection represent stages in the life history of the new plant.

Premising that our remarks will be understood to apply to agricultural plants alone, we can illustrate our position by outlining a classification for roots.

When a wild plant is brought, through its seed, to the garden, and grown in rich soil and protected from weeds, the change in size of the root may be at once manifest, and the root may be smoother and less branching than in the plant under natural conditions, but the type of form of root remains the same even under many years of continued cultivation, unless modified by the process of selection. These protected, yet not domesticated roots, have this feature in common: the diameter of the root in its upper portion does not exceed the diameter at the stem and leaf insertion. Examples are the Scorzonera, salsify, Scolymus and horseradish. Fig. 1, Scolymus, and salsify, represents the type, of which salsify is at the farthest remove towards improvement. These plants become feral without change in the type of root.

Passing now to domesticated roots, we find two separate classes of selections with, in some measure, like selections within both. The first includes the tap-rooted forms, the second the caudate

forms. The parsnip is so little domesticated that its root-forms in general come within the first class, while the beet, carrot, turnip and radish present forms which can be referred to both classes.

Scolymus.

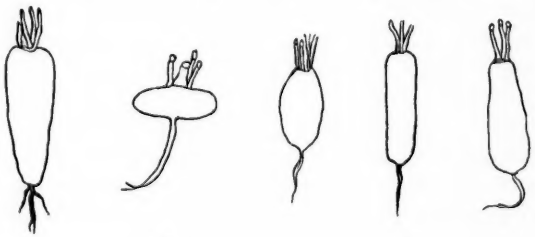
Salsify.

FIG. 1.

FIG. 2.

The first stage of the domesticated root is, that the upper portion of the root has a diameter in excess over that of the stem, and Fig. 2 represents the type of tap-rooted forms, in which the bulbous portion may be cone-form, cylindrical or almost globular, but in all cases the swollen portion tapers into the root.

The second stage of the domesticated root is the caudate, wherein, regardless of the form of the swollen portion, the root starts abruptly from a flattened surface, and gives a caudate appearance. The sub-stages within this stage represent the highest and most improved forms, and are represented in Fig. 3; *e*, or the tankard-



a *b* *c* *d* *e*

FIG. 3.

shaped, being the mark of extreme domestication, and each one of the types figured standing for the motive impressed upon the plant through conscious selection, and widely divergent from the forms which appear in nature as having no relations of advantage with and for the feral plant.

On account of the inter-relations of the two botanies, brought

about through the hereditary relationships of plants, the wild plant being the progenitor of the cultivated, it becomes essential to employ a symbol whereby agricultural relationship may be expressed without expressing conclusions as to botanical relationship as true species. A * placed after the generic name is what I propose. Thus *Tragopogon porrifolius* would be the scientific name for the salsify in Fig. 1; *Daucus * carota* for the cultivated carrots in all their forms, in order to distinguish them from the wild carrot, *D. carota*, etc., and ultimately a name for each stage or sub-stage of selection which has acquired fixity of type, as *D. * acuminatus*, the tap-rooted or stage 1 carrots, *D. acuminatus teretus*, the cylindrical tap-rooted carrot, etc., and within each of these agricultural forms, the varieties therein belonging to be grouped and described. It is thus seen that every type of cultivated plant-form which possesses constant characters under continuance of man's protection, and which differs from other type forms, would form an agricultural species; and that the same specific name would serve with the various genera of plants that have been forced to assume the same motive in development of form, as *Daucus * acuminatus teretus*, the cylindrical tap-rooted cultivated carrot, *Raphanus * acuminatus teretus*, the cylindrical tap-rooted cultivated radish, etc.

In the preliminary work in a new science much in the beginning must be provisional in its character, and hence we have selected for illustration a well-defined group of roots, leaving for later consideration the fascicled forms, as occur in the sweet potato and skirrit, as well as certain forms not as yet sufficiently studied. We but seek at this time a presentation of our views in order to invite discussion, and to secure coöperation, if our attempt is justifiable, from botanists whose studies include horticulture in its various branches; for if we are correct in our reasoning, the system, whose keystone is motive, must necessarily be applicable to all forms of changes produced by man's interference with nature. Of one thing we are assured through trial, that by using the motive given to the plant by man as furnishing data for classification, and by the study into the historical or probable sequences and stages of selection, we are enabled to form logical divisions and subdivisions in our garden forms, whereby identification of varieties by description has been furthered, and thus the study of domesticated plants in their economic relations has been rendered more easy for us to pursue.

THE NATURALIST BRAZILIAN EXPEDITION.

Paper III.—São João do Monte Negro.

BY HERBERT H. SMITH.

(Continued from page 470, May number.)

THE large Felidæ are now rare near São João, but individuals of all the species are still occasionally met with. The *Felis onca*[1] here roams indifferently in the highland or lowland forest; occasionally it attains a length of eight feet from the nose to the root of the tail, and in fierceness and strength it is probably not inferior to a lion. This species is characterized by black spots arranged in groups or circles of five or six each, on an ochre or tawny ground. Throughout Brazil there are two other species which heretofore appear to have been confounded with this one by naturalists. The first is the *onca pintada*, *Uriauara* or *onca cachorro* of the Amazons. This is quite as large as the true *onca*, and higher and thicker in proportion. The skin is readily distinguished; the colors are nearly the same as in the *onca*, but the spots are smaller and scattered evenly—never arranged in groups. The other species is the one which is known everywhere as the *tigre*, or black tiger. It is even larger than the others, the skin being of a deep glossy brown-black, marked with still deeper spots which are arranged as in the true onca. The skin of these three species can always be readily distinguished, and the hunters, who, in such cases, are the best judges, declare that the mothers give birth to cubs which are similar in pattern and coloration to themselves. Very rarely, it is said, crosses between two of the kinds are seen, and it is possible that skins of these crosses, appearing in European museums, have caused the confusion of species.[2]

The puma, or *leao*, as it is called here (*Felis concolor*), is smaller than the *onca*, and more common; it kills sheep and calves, but never attacks a man unless driven to bay. The hunters speak of several varieties, but do not regard them as distinct species. The puma does not cross with the three preceding kinds.

[1] Called here simply *onca*, or *jaguara;* on the Amazons, *Yauara sororoca;* in Matto Grosso, *Cangussú.* On the Amazons this species belongs properly to the flood-plain, while the *Uriauara* is exclusively a highland form.

[2] Prince Maximilian very clearly indicates the three species, but supposes that they may be varieties.

The *jaguaritica*[1] is a spotted cat, smaller than the puma; it appears to be allied to the *F. onca*, but the spots tend to run into longitudinal stripes, and the animal is never more than five feet long. Two still smaller spotted kinds are known here, one of which is marked much like the *jaguaritica*, but on a grayish instead of a yellowish ground; the other has small black spots on an ochreous ground.

Finally, there is a gray, unspotted species,[2] not much larger than the domestic cat. All these small species are readily tamed if taken young. We had a *jaguaritica* kitten in the house for several weeks. When brought to us it was as large as a three-months-old domestic cat, and its eyes were not yet open. It soon learned to feed from an ordinary nursing bottle, and it became very affectionate and playful, following us around, and climbing into our laps when we sat down. Its cry was like that of a domestic kitten, but shorter and sharper. We had hopes of rearing it and carrying it to the United States, but after awhile, without any visible cause, it sickened and died.

Foxes appear to be exclusively confined to the high prairies; I believe that the differences of color shown by individuals are only varietal A kind of wild dog is found in the forest, but we did not obtain specimens, and I am unable to judge whether or not it is merely a form of the domestic dog which has run wild. The *Mao pellado* (literally bare-handed) is a reddish-brown dog-like animal, one of the commonest mammals of this region; the legs are long, and on the lower part have only very short, scattered hairs, whence the name. It is nocturnal, wandering on the ground in woods and ravines, and occasionally visiting cornfields to devour the tender ears. It also eats nestlings and eggs. Two

[1] *Onca vermelha* on the Amazons; *Pardo* in Matto Grosso. Called also *Suacurana*, a Guarany name meaning false deer.

[2] The two smaller spotted species and the gray one are called indiscriminately *gato do matto* or forest cat in Rio Grande do Sul and in Matto Grosso. On the Lower Amazons the small spotted species are termed *maracajás*, and only an unicolored kind is named *gato do matto*.

I have not attempted to name the species, partly because, writing in the field, I have no books of reference at hand, and partly because the nomenclature is still in confusion. There will, of course, be much difference of opinion as to what constitutes a species among these Felidæ, but so long as the various forms can be readily separated, and do not ordinarily cross with each other, it appears better to regard them as distinct. Whether they are "species" or "races" or "varieties" is a question of very little importance.

cubs are generally produced at a birth. The *Mao pellado*, if taken young, may be domesticated, but it never becomes thoroughly tame; it has a very strong, disagreeable odor, which makes it an undesirable pet.

Of the *Coatis (Nasua)* two species are found here as in other parts of Brazil. The larger, called *Coati-mundê*,[1] resembles a raccoon, but stands rather lower, and is readily distinguished by its long snout; the *Coati-miry*[2] is smaller. Both are rather nocturnal in their habits, and rather frugiferous than carnivorous; two cubs are produced at a birth. Tame coatis are often seen, but as they are very mischievous and rather ill-natured, they are generally kept chained.

Two kinds of otters, the *lontra* and the *ariranha*, are occasionally seen about the rivers. The *lontra* appears to be identical with the Amazonian species of the same name. It never wanders far from the stream or river in which it lives, and when alarmed it quickly takes to the water, swimming at the surface and raising its head to stare at the intruder with a short bark. These otters, if taken young, become very tame, and they may be taught to bring in fish. I knew of one on the Lower Amazons which accompanied the village boys in their frequent baths, diving about with them and evidently enjoying the fun. The *ariranha* is much larger, and when swimming against the current it often advances by a series of leaps above the water; in this way it will distance a steamer. In Matto Grosso I have seen two of these animals keep before an ascending steamer in a swift river for more than an hour.

A small skunk is found along the borders of woods, but I do not think that it is properly a forest animal. Its habits are similar to that of the North American skunks, but though its scent-gland is well developed it is seldom used. On one occasion a living specimen was brought to us in a sack; we allowed it to run about the floor and found that it had hardly any unpleasant odor; even when we killed it, it did not attempt to use its characteristic defensive weapon. It may be that the gland only becomes active at certain periods.

Capivaras[3] are still common by the river-shore, where they

[1] In Guarany, literally the trap-coati; corrupted to *Coati-mundi* or *mundêo*.

[2] Guarany, little Coati.

[3] From the Tupy-Guarany *iaapê*, grass; *uára*, that lives in or among.

subsist principally on grass and leaves; they are very stupid and tame, and so heavy in their movements that it is no difficult matter to catch them alive. When pursued they generally take to the water, swimming with part of the head above the surface. I have frequently seen Capivaras running about with cattle, and in less populous districts they will allow a man to pass within a few yards of them without showing alarm. Living specimens are sometimes seen about houses, but they can never be thoroughly tamed. The skin is prized for making whips and cords; it has a black outer cuticle which scales off soon after the animal is killed, so that it is difficult to obtain a perfect specimen. The flesh is considered unfit for food, owing to its unpleasant flavor; but when the animal is skinned and cleaned soon after its death, this is not noticeable; the meat is then very good, as I can attest. The female Capivara is generally seen with several young, all of different sizes, though it is said that they have only one or two at a birth. If the common reports are true, conception must take place several times during gestation. An intelligent hunter assured me that he had found six fœti, all of different sizes, in the womb of a Capivara; the largest was on the point of being born, and he succeeded in keeping it alive for several weeks. I have heard similar stories from other quarters; but other hunters deny their truth, and say that from six to ten young Capivaras are produced at one birth.

Allied to the Capivara, and resembling it in form, are two small rodents, the *priá* and the *micó*, both found on the Campo; the latter, it would appear, extends northward as far as the River Parnahyba, but it is rare in Rio Grande do Sul, where the *priá* is common.

Pacas are the largest forest rodents, they are now rare in this part of the province, their excellent meat causing them to be sought after by the hunters. They are properly nocturnal, eating fruits and roots. Of the allied Cotias there appear to be two kinds here, and I am inclined to think that many species, differing in slight but constant characters, will be found in South America. The Cotias are diurnal, and subsist on fruits. Of other rodents we collected only a small blackish squirrel, a porcupine and a curious forest rat with a very elongated body; all of these are rare, and I could learn nothing of their habits. A small rabbit is found on the Campos, and there is a kind of rat

(*rato da taquara*) which occasionally appears in immense numbers, though it is generally very rare.

Tapirs, or *antas*,[1] are now very rare near São João, though they are common in the less settled parts of the province; in the equatorial forests of Brazil they are among the most abundant animals. They wander only in the high forest, coming to streams at night to drink and wallow; their food consists of leaves and fruits.

Tapirs are readily tamed, and they are rather affectionate and intelligent pets. A friend of mine once suffered a terrible fright from a tame tapir. He was passing the night at a Brazilian house where one of these animals was allowed to roam about at will. My friend slept in a hammock, whence, about midnight, he was very rudely ejected by a large animal which attempted to pass underneath him; as the hammock hung low, the animal's back acted on it like an earthquake, and the sleeper tumbled out. Awakened thus suddenly, he threw out his hands, to find them in contact with a rough, cold skin. A yell of terror brought the other inmates of the house, and the offending tapir was ignominiously dragged away; but my friend did not soon recover from his fright.

The two kinds of wild hogs found here seem to correspond with the species (*taiassú* and *caititú*) found on the Amazons and in Matto Grosso. Both wander in small droves, eating fruits and roots; they are seldom seen on the open lands, and when found there they quickly seek refuge in the forest. Once under the trees they are apt to show fight, facing the hunter and gnashing their long tusks. Their meat is very good.

Two kinds of ant-eaters, the large *Tamanduá bandeira*[2] and the medium-sized *Tamanduá pequeno* are found here; the first appears to walk only on the ground, but the *tamanduá pequeno* often climbs trees in search of ants' nests. The small nocturnal climbing species does not appear to be found here. In a wild state the tamanduás seem to feed only on termites and insect larvæ, but they may be tamed, and they will then eat rice and bread. We

[1] Our word tapir, the Latin *tapirus* and the French *tapir* come from the Tupy-Guarany name *tapiira* or *tapiir*. *Anta* in Portuguese means an elk.

[2] Banner ant-eater, in allusion to its broad, spreading tail, which it often holds over its back; on the Amazons it is also called *tamanduá-assù*, the great ant-eater. *Tamanduá* appears to be derived from the Tupy-Guarany *taá*, an ant, and *mundê*, a trap.

once kept a young *Tamanduá pequeno* in the house for two or three weeks, feeding it on milk, which it sucked or lapped from a saucer. It became quite tame, following us about awkwardly by walking on the sides of its feet; if allowed to do so it would climb to our laps, clinging tenaciously to trousers or skirt by holding the cloth with its strong hooked claws turned back on the palms. Though this specimen was a mere baby the claws were formidably strong, and after one or two trials none of us cared to trust our fingers to them. When first brought to the house it expressed its fear by short whines or grunts, and afterward it gave vent to similar cries when hungry. It was fond of heat, often stretching itself on the ground in the sunshine with all four legs wide apart. Like all young specimens this was much paler in color than the adults, approaching to yellowish-white. Occasionally old tamanduás are found with the same tint, and the hunters regard these as a distinct species, but I believe that they are albinic varieties.

Three kinds of armadillos or *tatús* are mentioned by the hunters in Rio Grande; of these we obtained two, belonging to different genera. The larger, which sometimes grows to a length of three feet, seems to be almost exclusively a feeder on carrion; it makes deep burrows, breaking the earth with its strong claws, and sometimes it is said digging into graves. The other is much smaller, never more than eighteen inches long, and it feeds on white ants, small fruits and so on; tame ones make most amusing pets, running about the house and poking their inquisitive noses into every crevice. This kind is eaten, the meat being white and very good; but it is a singular fact that dogs will not touch it. A still smaller *tatú*, sometimes seen here, is characterized by a truncated and somewhat hairy shell. All these species live in clearings, *fachinal* forest or open campo; never, I believe, in the main forest.

A large opossum is common in the woods, living in hollow trees and eating small birds, etc. It is strictly nocturnal, and apparently is quite unable to see during the day time; the hunters generally take it alive, carrying it by the tail. When tormented it hisses much like a goose, and tries to bite. It is exceedingly tenacious of life, living after its back bone and skull are both broken; I have even known one to live for some time, and attempt to walk and bite, after its heart was taken out.

A female opossum was brought to us with six well-grown young ones, as large as three weeks' old kittens; they clung to the mother's back, twisting their prehensile tails around hers, and apparently looking upon her as their protector; but during the succeeding night they all escaped through a hole, leaving the mother, who could not follow, behind. One or two small opossum rats are also met with; they climb over the small branches of trees and, like the large species, are unable to see in the daytime. I could learn nothing of their habits.

Passing by some less interesting species, I may here devote a page to our tame monkey, Bildad or Billy as we generally called him. This was a very small gray marmoset from Pernambuco, which I had bought of a sailor in Rio de Janeiro. Being much petted, and allowed to run about as he pleased, he became very tame; rather an unusual thing with this genus, for the marmosets are generally rather wild and timid. Even at his best Billy was somewhat fractious, always biting if we attempted to seize him, though he came to us readily enough if we offered a hand. He was especially attached to my wife, spending hours on her shoulder or on her head, his four arms spread out and his hands clinging fast to her hair; if she put her hat on over him so much the better, if neither head nor shoulder could be had he would crawl up a sleeve or under a vest, always turning to poke his inquisitive face out to see if we were observing him. When in a playful mood he delighted, as a child might, in a game of "peek-a-boo," dodging from side to side behind a cushion and keeping up the game as long as anybody would dodge after him. About once a day Billy was seized with a wild spirit of fun and a tremendous romp took place. He would leap from one to the other, rushing over us from feet to head, snapping at our noses, pulling our eye-winkers, playing bo-peep from our sleeves, and throwing himself on his back to bite his own toes in an ecstasy of enjoyment. Suddenly, in the midst of a rush, he would stop short, draw back the corners of his eyes, and make an indescribable face at one of his observers; seen for the thousandth time this always provoked us to shouts of laughter, whereat Billy would scuttle away and turn a somersault on the bed. Sometimes for a joke we would put him inside of a large trumpet-flower or in a lamp-chimney or tumbler, and he seemed rather to enjoy his imprisonment. When left to his own resources he ran about the house, sunned himself in a neighboring tree, or

caught flies by approaching them very slowly and grabbing them with one hand. If long neglected he became aggrieved; then he would find some conspicuous perch and give vent to his troubles in a series of shrill screams. If still unnoticed he would scream yet louder, his face expressing, as only a marmoset's can, the depth of his feelings; the hair on his forehead standing on end, and his whole body trembling with rage. But the exceeding force of his vocal powers was only displayed when we punished him, or when—rare and dreadful occurrence—he was washed; then indeed his lamentations became shrieks and every line of his face evinced his abhorrence and wrath. On such occasions Billy could only be appeased with a comb; for to be combed was his idea of perfect happiness. As soon as he felt the delightful touch all sounds would cease; with eyes fixed on vacancy and face expressive of speechless bliss, he would stretch out all four arms and lie quite still as long as we pleased to comb him. He would then submit to lie on his back while his breast was combed, or he would cling with his two front hands to a friendly finger, and with two hinder hands to a chair, while his body was stretched to its utmost length; he would even hang by his hinder hands with his head down, or let us hold him up by the tail.

Billy, having never known a wild life, cared nothing for liberty; if lost in the forest, as happened once or twice, he soon brought us to him by his screams. He slept in a little basket, but generally broke out before morning and climbed to my wife's bed, nesting on her shoulder. Sometimes we carried him in the basket while on our journeys, and he was always well contented so long as he felt that he was moving; but if we laid the basket down he presently broke into his usual heart-rending jeremiad. Our first attempt to carry him on horseback resulted well until Billy noticed the horse; then a scream of terror was followed by a wild rush for some hiding place, and he eventually took refuge in the top of one of my great riding-boots. He was intensely afraid of cats and dogs, but cared nothing about birds, turtles or snakes. We had a tame land-tortoise which sometimes shared Billy's basket and the tortoise was frequently robbed of his dinner by its room mate, who would sit on its back and cooly devour the spoil. The monkey ate almost any vegetable, and even a little meat; he was especially fond of almonds and of cheese, both of which generally resulted in indigestion. He also had an

undue fondness for tragacanth paste, which we sometimes used in our work, and if we covered the paste cup he would spend hours trying to pry the cover off. Being spoiled, he was rather saucy, considering that he had the first right to every dish on our table, and helping himself without ceremony, especially to the sugar and milk; brandy he would take if it was well sweetened. Once or twice, while we were living at a hotel, Billy broke loose at dinner time and astonished the boarders by racing over the table to my wife's chair, ending by sitting on her shoulder and making one of his inimitable faces at the assembled people. One day when he occupied his usual place near us a nicely ornamented boar's head was brought in with grinning jaws and staring eyes made of lemons and olives; the monkey, who had never seen the like, put out both hands as if toward the apparition and retreated with a yell to the farthest corner of the room, whence he was taken trembling.

When we first brought him home Billy's curiosity was much excited by the looking-glass in which he saw, as he supposed, another monkey; having tried in vain to reach his playmate from the front, he looked around the glass and was evidently disappointed at finding nothing there; this performance was repeated at intervals for some days, but after awhile he became accustomed to the phenomenon and did not notice it further. He was fond of bright colors, gilt buttons, glass beads and the like; often he tried to pick the flowers from my wife's muslin dress; grasshoppers and beetles were a treat to him, though he seemed to care more about tearing them to bits than eating them; he learned after repeated punishments that he must not touch our collections, though he sometimes stole a specimen on the sly.

As the cold weather came on Billy grew sickly, keeping much to the shelter of his basket. One morning he woke in strong convulsions, which were followed by others in quick succession. Coming out of the last he lay quiet for a moment and we had hopes of saving him; but, as my wife extended her hand to him, he stood up with an effort, made one of his drollest faces at her, and fell over dead. I suppose that there was not a dry eye in the house when we buried him—my wife had resented as sacrilege the idea of saving his skin for a specimen—and we all agreed that no more playful and affectionate pet had ever been seen. Weeks afterwards I found my wife furtively placing flowers on his grave.[1]

[1] I have tried to describe the marmoset's habits accurately and literally, and no part of the account is exaggerated.

ON THE EVIDENCE THAT THE EARTH'S INTERIOR IS SOLID.

BY DR. M. E. WADSWORTH.

IT is well known that the facts of geology require some mode of escape from the now generally-received opinion that this earth is a solid globe. This is especially shown by the introduction of so many hypotheses to avoid the logical consequences incident upon such a globe. Some of these hypotheses are lakes of still unsolidified material; masses of readily fusible materials; aqueo-igneous solution of sediments; fusion of the earth's interior on the removal of pressure; a solid crust and a solid core with a zone of liquid matter between, etc., etc. All these views are simply compromises between the known fact that some part of the earth must be liquid in order to account for geological phenomena and the supposed physical and mathematical demonstrations of the earth's solidity. These compromises are unnecessary if it can be shown that the claims for the earth's solidity are not well based.

The facts of petrography likewise seem to the writer to demand the belief that all eruptive rocks have come from the earth's interior, below any of the sedimentary deposits. Also that they must have come from material that has either never been solidified or else has been reliquified.

This paper has arisen out of the fact that to the writer's mind there appeared a diversity between the commonly taught hypothesis of the earth's structure and observed petrographical facts. He therefore undertook an examination of the principal published data in order to see whether the error resided in the petrographical observations or in the data for the hypothesis of a solid earth. The result led to the writing of this paper nearly two years ago, and it now stands essentially unchanged. Its object is to place before others the chief lines of argument in behalf of a solid earth and to indicate that geology and petrography have as yet the right to assume any structure for the earth's interior consistent with known facts, without regard to the so-called physical and mathematical demonstrations of its solidity.[1]

The Evidence of the Earth's Solidity derived from Precession and Nutation, and the Tides.—The most prominent of the early advo-

[1] *Science*, 1883, I, 127–150.

cates of the essential solidity of the earth, was Mr. William Hopkins, who based his conclusion upon the phenomena of precession and nutation. In order to mathematically investigate this question, he made two assumptions regarding the earth: 1. That it was composed of a homogeneous fluid mass contained in a homogeneous solid shell. 2. A heterogeneous fluid inclosed in a heterogeneous solid shell. In both cases the transition was assumed to be "immediate between the entire solidity of the shell to the perfect fluidity of the interior mass." He further assumed that the circulation would go on in every portion of the mass until it had lost its perfect fluidity throughout the entire mass at nearly the same instant. This of course could only be correct if the liquid was homogeneous. He did, however, state that a viscid condition of the liquid would prevent the descent of the cooled exterior portions towards the interior. With a globe constituted as above for his basis, Hopkins concluded that the phenomena of precession and nutation did not demand on the earth a crust of over 1000 miles in thickness, but they did require one at least 800 miles thick. In order to account for volcanic phenomena, he assumed that there were in the solidified crust, lakes of molten material whose origin was to be ascribed to a greater fusibility of the material composing them, than of that forming the surrounding solid crust.[1]

Professor Hennessy later held[2] that in a fluid globe the denser particles would sink through the lighter, while the lighter ones would ascend through the heavier, until an equilibrium of the mass would be reached, so that the globe "would consist of a series of spheroidal strata, each of uniform density throughout its own mass." He further remarked: "The exterior portions of the fluid would cool first, until they would acquire, according to the particular circumstances which may influence their cooling, certain densities. If the effect of refrigeration be in general an increase in density of the matter cooled, then the cooled portions of the fluid will sink. The higher temperature of the matter yet unexposed to cooling influence would then tend to change the acquired densities of the cooled matter. The as yet uncooled fluid would have its temperature reduced from contact with the cold particles from above, and it would tend to change its posi-

[1] Philos. Trans., 1839, pp. 381–423; 1840, pp. 193–208; 1842, pp. 43–55.

[2] Philos. Trans., 1851, pp. 495–547.

tion in a similar manner to the portions first cooled. As each cooled portion of the fluid descends, the three following causes would therefore impede its descent:

1st. From the arrangement already indicated of the denser strata about the center of the mass, and from the nature of the law of density of the strata, each stratum into which the cooled fluid would descend, would be denser than the preceding.

2d. If the general effect of the refrigeration be to increase the density of the cooled matter, each stratum would have its density augmented by the passage through it of the cooler matter from above.

3d. The descending portions will have their densities diminished by the increase in their temperature.

With an earth thus constituted for his starting point, Hennessy concluded that its crust could not be less than eighteen miles thick nor more than 600 miles. He further claimed that owing to friction, viscidity, and pressure it was probable that the fluid interior and the solid exterior would rotate nearly as if the earth was solid from its center, thus denying the validity of Hopkins' conclusions.

Professor Samuel Haughton, starting from the assumed premise that the earth was "composed of a solid shell, having the density of the rocks at the surface and a fluid homogeneous nucleus," also having a fluid heterogeneous one, deduced 768 miles as the probable thickness in both cases.[1]

The conclusions of Hopkins were sustained by Sir William Thomson. He starts with the hypothesis that the earth is composed of a thin shell which passes abruptly into a homogeneous incompressible fluid, mobile like water, which forms the interior. He also assumes that this liquid interior is heterogeneous and viscid. Taking for his starting points globes such as these, he concludes that the earth is more rigid than a homogeneous globe of glass and probably than one of steel.

Thomson further claimed that it was demonstrable that the earth solidified from the center, because melted rock contracted on solidifying, and that hence the crust would sink to the center as soon as formed.[2]

[1] Trans. Roy. Irish Academy, 1851, XXII, 251–273.

[2] Trans. Roy. Soc. Edin., 1864, XXIII, 157–169; Phil. Mag., 1863 (4), XXV, 1–14, 149–151; Phil. Trans., 1863, pp. 573–582; Thomson and Tait's Natural Philosophy, 1867, I, 670–727; Trans. Geol. Soc. Glas., 1878, VI, 38–49.

Thomson's views were republished and reaffirmed in 1872,[1] but in 1876 he says, regarding his previous argument from precession and nutation, as the result of a conversation between himself and Professor Newcomb: "Trying to recollect what I had written on it fourteen years ago * * * my conscience smote me, and I could only stammer out that I had convinced myself that so-and-so and so-and-so, at which I had arrived by a non-mathematical short cut, were true. He hinted that viscosity might suffice to render precession and nutation the same as if the earth were rigid, and so vitiate the argument for rigidity. This I could not for a moment admit, any more than when it was first put forward by Delaunay.[2] But doubt entered my mind regarding the so-and-so and so-and-so, and I had not completed the night journey to Philadelphia, which hurried me away from our unfinished discussion, before I had convinced myself that they were grievously wrong."[3]

Thomson, however, strongly affirmed the correctness of his views regarding the rigidity of the earth as determined by the phenomena of the tides. It is permitted, since he still retains his view that the crust when formed would sink, from its weight, to the center, to think that if he would affirm the precession and nutation theory, for fourteen years, so often as he had, without giving it sufficient thought, that possibly with the very imperfect tidal data at his command, he has not looked at this question in all its bearings.

Professor Hennessy indeed in 1872 pointed out that Thomson had assumed a spheroidal homogeneous elastic shell filled with incompressible fluid, and that all the latter could claim to have proved was, "that the earth does not consist of an elastic solid envelope enclosing a mass of the ideal substance called an incompressible liquid." Hennessy also justly calls attention to the fact that Thomson's method of proving the rigidity of the earth by assuming, first, that it is a homogeneous mass of glass, and again of steel, is an argument of the same kind, as if one should attempt to prove that rapid locomotion in railway trains was impossible, on account of the shocks the passengers would

[1] *Nature*, 1872, v, 223–224, 257–259.

[2] This is an error of Thomson's, since Hennessy advanced this view in 1851, seventeen years before Delaunay. See *Nature*, 1871, III, 420; *Geol. Mag.*, 1871 (1), VIII, 216–218.

[3] Report Brit. Assoc., 1876, XLVI (Sect.), 1–12.

be subject to, by assuming as his premise that the carriages were rigidly attached to one another.[1]

Delaunay further objected to the precession and nutation theory of Hopkins and Thomson, on account of the slowness of the motion and the viscidity of the liquid interior, which would cause the earth to act as if it were a solid body.[2]

From observations made on the deflection of the plumb-line by the Himalaya mountains, Sir George B. Airy held, "that the whole of that country is floating upon a dense fluid, and that the thick mass of the lighter mountain-matter sinks deep in the fluid, and that the displacement of denser matter neutralizes almost entirely the attraction of the lofty mountains. The form of the earth is not such as would be taken by a solid structure, but such as would be taken by a fluid mass with solids floating upon it."[3]

In the case of Mr. Geo. H. Darwin's papers, it is difficult in some cases to understand exactly what he regards as the constitution of his assumed mathematical globes, and to express his ideas in non-mathematical language. His investigations appear to be made on the suppositions that the globe is a viscous non-elastic spheroid, an elastico-viscous one, and one either elastic, plastic or viscous. All these, if he is rightly understood, are considered to be homogeneous. Darwin then states that the chief practical result of this paper may be summed up by saying that it is "strongly confirmatory of the view that the earth has a very great effective rigidity," the term earth being substituted for the hypothetical globes mathematically investigated by him."[4]

In one paper he says that the word earth is used as an abbreviation for "a homogeneous rotating viscous spheroid."

In a later paper "On the stresses due to the weight of continents," he assumes that the earth is a homogeneous elastic sphere, of which two conditions are possible, one that it is incompressible, the other that it is compressible. He then proceeds to show that in an earth thus constituted a state of stress must exist, owing to the inequalities between the continents and sea floors. From the discussion of this supposed condition, he says: "It appears that if the earth be solid throughout, then at a thousand miles from the surface the material must be as strong as

[1] *Nature*, 1872, v, 288, 289.
[2] *Geol. Mag.*, 1868 (1), v, 507–511.
[3] *Nature*, 1878, xviii, 41–44.
[4] Philos. Trans., 1880, clxx, 1–35, 147–593.

granite. If it be fluid or gaseous inside, and the crust a thousand miles thick, that crust must be stronger than granite, and if only two or three hundred miles in thickness much stronger than granite. This conclusion is obviously strongly confirmatory of Sir William Thomson's view that the earth is solid throughout."[1]

This statement of Professor Darwin seems to me misleading, for if his paper is understood aright, he has proved nothing of the *actual earth*, but only of a *hypothetical homogeneous elastic incompressible or compressible globe*, and for this assumed globe he has substituted the term *earth*, the same as the algebraist uses the terms x and y.

Is there a single geologist who believes that it is possible for this earth to have any such structure as that assumed for it by Thomson, Darwin and others? The difficulties placed by the physicists in the way of a belief in the earth's liquid interior, seem to be of their own making. These difficulties arise from the assumptions and limitations that the physicists have to impose upon the problem to bring it within the range of mathematical analysis. They have taken premises that no geologist would take, and having proved their point regarding these assumed premises, then claimed that they have proved it for this *earth*. What physicist has taken as his basis the most probable condition of the earth if its interior is liquid; a heterogeneous, viscid, elastic, liquid interior, irregularly inter-locked with and gradually passing into a lighter heterogeneous crust? The problem is believed to be beyond the power of any transcendental mathematics now known, and it is not believed to be possible mathematically to prove, at present, anything regarding the actual state of the earth's interior.

Our conclusions as to that state appear to be dependent on the evidence that can be derived from geological and petrographical studies. Professor Hennessy appears to have taken, as the basis for his mathematical discussion, data that are nearer the probable constitution of the earth than those assumed by any one else, and his results are entirely consonant with the hypothesis of a fluid interior.

It is as necessary that physical and mathematical discussions of the state of the earth's interior should conform to geological facts, as it is that geological theories should conform to physical and

[1] Philos. Trans., 1882, CLXXII, 187-230.

mathematical laws. It is incumbent on the physicist to explain earthquake motion, the sinking and rising of different portions of the earth's crust, volcanic phenomena, the uniformity in composition of lavas, the structure of volcanic rocks, sedimentation, faulting, vein formation, etc., etc., by his theory of a solid globe. Geological *facts* are just as positive as physical ones, and it is as necessary for the physicist to reconstruct his theory of a solid earth to suit geological facts, as it is for geologists to reconstruct their theories to suit the so-called physical demonstrations of a solid earth—demonstrations that merely show that under the assumed conditions and hypotheses the physicist's imaginary globe must be a solid one.

Are not speculations, speculations still, even if threaded together by a long series of mathematical formulæ, and are not all so-called mathematical proofs of the earth's solidity the mere working out of certain assumptions? Huxley was indeed right when he said, as the present writer would like to say: "I do not presume to throw the slightest doubt upon the accuracy of any of the calculations made by such distinguished mathematicians as those who have made the suggestions I have cited, * * * but I desire to point out that this seems to be one of the many cases in which the admitted accuracy of mathematical processes is allowed to throw a wholly inadmissible appearance of authority over the results obtained by them. Mathematics may be compared to a mill of exquisite workmanship, which grinds you stuff of any degree of fineness; but, nevertheless, what you get depends on what you put in; and as the grandest mill in the world will not extract wheat-flour from peascods, so pages of formulæ will not get a definite result out of loose data."[1]

Not only in mathematical and physical science, but in all science, no amount of discussion can give the conclusion any greater strength than the premises have, but attracted by the conclusion or by the chain of argument, the data are apt to be overlooked. Were this not the case many a structure, reared with great care and now regarded as established, would be found to rest on flimsy foundations.

So far then as the mathematical and astronomical determinations of the earth's solidity are concerned, it would seem that great doubt exists as to the correctness of the premises as applied to the earth, and hence like doubt regarding the conclusions.

[1] Presidential address. Geol. Soc. London, 1869, p. 1.

When calculations shall be based upon the best data obtainable as to the materials of the earth's interior and their arrangement therein, then, and not till then, will mathematical calculations have real weight that geologists are bound to respect, but that day is a far distant one.

In the mathematical discussion of the state of the earth's interior, it has been customary to select a homogeneous globe of uniform density, but when the earth has been assumed to be heterogeneous and of varying density, it has been regarded as composed of layers, the layers being of unequal density when compared with one another, but of equal density throughout their own mass.

The more probable condition is that of a globe with a gradual increasing density from the exterior towards the interior, but with the materials heterogeneously arranged in the so-called layers. While the heavier materials would increase in abundance and the lighter diminish as the interior was approached, and *vice versa*, these materials at any one point would be found to be mixed together in varying proportions, the same as they are in meteorites and terrestrial eruptive rocks. While the extremes of the series may, indeed, be free from one another's components, the intermediate layers would contain more or less of the materials that predominate in the other portions of the earth's interior.

(To be continued.)

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VESTIGES OF GLACIAL MAN IN MINNESOTA.

BY MISS FRANC E. BABBITT.

DURING the open winter of 1878–9 and the seasons immediately succeeding it, the writer of this paper chanced to be engaged in searching certain terrace surfaces of the Mississippi river for palæolithic remains supposed to exist at the locality under examination. Rudely worked quartzes had previously been discovered here by the State geologist of Minnesota, Professor N. H. Winchell, by whom they had subsequently been described and figured in the State geological report for 1878. The field of exploration lies in central Minnesota, about one hundred miles northwest of St. Paul, and within the township and small village of Little Falls, Morrison county. Its area is at present restricted

to a narrow section of the Mississippi valley, stretching along the river a short distance from the central site of observation.

The find reported by Professor Winchell consists of chipped objects of a class generally ascribed to what is called the *rude stone age*. Of these, many appear to be mere refuse, while others are regarded as finished, and unfinished implements. The Winchell specimens have been assigned, upon geological grounds, to a prehistoric era altogether antedating that of the mound-building races, and reaching back to a time when the drift material of the terrace-plain was just receiving its final superficial deposit. It is found that, at intervals, the surface soil of the terrace is permeated with these quartzes to a depth of not unfrequently three or four feet.

The lowest and newest formation at this place constitutes the actual flood-plain of the river. It is still in process of development, is of fluctuating width and thickness, and is, at certain points, yet subject to partial overflow at periods of exceptionally high water. In that portion of the township of Little Falls situated east of the Mississippi, this bottom land is limited on the east by a higher ancient river terrace, which has, at the head of the rapid called Little Falls, an average elevation above the river of about twenty-five feet, with a width of a mile or more.

This older terrace, like the present flood-plain, is of undoubted *drift* origin, and has been spread out by the immediate action of water. Mr. Warren Upham, assistant on the State geological survey, tells us that it consists of stratified gravel and sand; that it forms a part of the modified drift, deposited at the close of the last glacial epoch of the great ice age, by the floods descending along this valley from the melting and retreating ice-sheet; and that it was derived from the drift material which had been contained in the lower portion of the ice. It belongs to the great system of river-terraces, extending from an indefinite beginning on the north, to the embouchure of the Mississippi on the south. Wherever from any cause the lower plain, or bottom-land, does not exist, the edge of the upper plain becomes, of course, the real bank of the river; at places where, on the other hand, the newer deposits appear in force, the ancient terrace-banks either abut directly upon them in a pronounced line of steeps, or descend to them by gentle slopes.

The upper terrace of the Mississippi valley is, at Little Falls,

defined on the east by a broken chain of uplands which take on different names in different parts of their course. Thus they are known in Wisconsin as the *Kettle range*, and in Minnesota and Dakota, as the *Coteau des Prairies* and the *Coteau du Missouri*, respectively. Geological authorities agree that the range indicated is a series of terminal moraines, and that it defines the limits attained by the great northern glaciers, at the acme of their southern advance, during the last of the universally recognized glacial epochs of North America. The morainic belt is regarded as an accumulation of débris, due to long-continued glacial halts, and alternations of advance and recession; the rubbish thrown down by ice melting while stationary or creeping back, at one time, having been plowed up and redistributed at the next subsequent period of forward movement. When the climate at length became permanently warmer, and the glaciers withdrew for the last time to the frozen regions of the north, they left their outline traced, as in a scroll of huge hieroglyphics, across the open page of the continent.

This morainic belt does not follow the lines of latitude, but descends to its southern limit in an irregular series of broad and often very long lobes. These touch each other, and merge into one at their lateral borders, on the east and west, while at the southern terminus each preserves an independent outline, taking on a rounded contour at the extremity, and ending in a more or less elongated curve prolonged towards the south. Thus we have, in southern Wisconsin, the well defined moraine of a great glacier descending from Lake Michigan into northern Illinois, the western edge of which was joined by the eastern margin of a similar ice-current coming down from Green bay. The débris of their united edges moved forward along the midst of their combined masses in a single line of aggregation, now known as a *medial moraine*. At the extremity, each glacier descended independently to the south, where the moraines of both yet exist in the form of two large, irregularly rounded lobes, joined at the base of the medial moraine.

Still west of the Green Bay moraine lies that of the northeast glacier, the western edge of which is skirted, at Little Falls, by the terrace-plain of the Mississippi river, as hitherto described. A few miles further west still, on the opposite side of the Mississippi, yet another moraine of the modern epoch comes down from

the northwest, but without impinging directly upon that from the direction of Lake Superior in the latitude of Little Falls, where the two are separated by an interval of several miles. As we are assured, however, by Mr. Warren Upham, the two finally come together in Stearns county, some little distance south of Morrison county. Geologically considered, then, the field of study lies in an ancient terrace-plain east of the Mississippi river, is situated precisely between the northeast and northwest moraines, and is, so far as the quartz stratum to be described is concerned, buried under an accumulation of modified drift deposited by glacial waters.

While occupied in examining the river bank in quest of wrought quartzes, one day during the season of 1879, I had occasion to ascend a slope lying between the new flood-plain and the older one, by a pathway leading through a sort of gap, or notch, in the latter. Henceforth I shall, for the purpose of more emphatic distinction, denominate the lower and higher levels under consideration as *bottom-land* and *terrace-plain*, respectively. It seemed that at some past period a cut had been effected here by drainage, and that the washout thus formed had afterward been deepened through being used as a wagon-track. In this notch I discovered the soil to be thickly strewn with pieces of sharp, opaque quartz. These were commonly of a white color, and ranged in size from minute fragments to bits as large as a man's hand, and in some instances even larger.

There were many hundreds of these chips visible, scattered over an area of the width of the wagon-track, and ten to fifteen yards in length. They were conspicuously unwaterworn and likewise, in the main, unweathered, though occasionally a bit was picked up having some one of its surfaces weathered, while fractured or wrought faces appearing upon other parts of it, looked as fresh as if the work of yesterday. On the other hand, the mass of stone rubbish upon and among which the quartzes were strewn, is much waterworn, many of the pieces being well rounded, while none of them are wholly angular.

Most of these quartz pieces had, when first observed, a sort of bleached exterior unlike that of the rusty-looking specimens subsequently exhumed from the stratum adjacent; but this was no doubt due to the complete superficial cleansing to which they had been subjected by recent exposure to the elements. At all events,

the bleached appearance proved a merely temporary characteristic, for although the quartzes received a thorough washing up immediately after being collected, they directly began to take on anew a tawny yellowish tint which, within a few months, became decidedly pronounced. They were again carefully cleansed with brush and water, again to resume their rusty tone of color. In a few instances the process of brushing clean was repeated at intervals of four or five months, a third and even a fourth time, with similar results. The degree of discoloration appears to vary with the quality of the specimens affected, the most compact varieties of mineral undergoing the least modification of tint. The coloring also fluctuates, probably, with the fluctuating proportion of iron in the containing soil.

It was soon ascertained that the notch, and the surfaces immediately surrounding it, afford no boulders nor other supplies of quartz except these chips. Nor does quartz appear on the east shore within a radius of perhaps an eighth of a mile from the spot, although it occurs plentifully just north and south of these limits, both in the form of veins in the slate rock of the region, and in that of waterworn river-wash and occasional boulders. Waterworn lumps of quartz are now and then found, it is true, in the subjacent till, but the latter lies several feet lower than the quartz-bearing stratum, beneath which it directly penetrates, and hence could never have yielded the specified objects through natural processes. An additional fact, worthy of note, is the invariably small size of the pieces disclosed. But a single fragment larger than a club-head has, as yet, come to light anywhere at the notch, and that one was not imbedded in the undisturbed strata at the notch proper, but in the débris at its base and west of it. Even could there have existed at this site masses of mineral important enough to furnish the tens of thousands of chips and lumps with which the place has proved to be paved, it appears wholly incredible that such rocky masses could have been thus absolutely annihilated, except through human interference. The waterworn stone rubbish below the quartzes remain undisintegrated, therefore so we should expect the latter likewise to be found. There is no known reason why, having been subject to the same influences, the one should have been broken into small pieces, and even splintered into the tiniest bits, while the other escaped disintegrating forces.

In view of the circumstances cited, it was finally concluded that the quartzes must have been artificially transported to their actual position, perhaps in fragments, perhaps in masses which were afterward broken into fragments. For a period of about four years the quartzes were largely augmented in number at every succeeding freshet, during which they were washed out of the inhuming sand of the roadway by descending drainage. Their immense and continually increasing quantity finally seemed to warrant the belief that they had resulted from systematic operations of some sort, once conducted, for unknown purposes, upon that particular spot. A portion of the studied specimens subsequently yielded evidence of having received shape from human hands.

The theory of neolithic origin was, from the beginning, beset with embarrassments. Certain incongruous developments became increasingly perplexing with the advance of investigation. The spot appeared to be peculiarly unfitted by nature for a base of quartz-working operations. It was unintelligible, for example, why an important industry of this sort should have been established at so great a distance from quartz boulders and quartz-bearing rock, especially as convenient plains occur about the nearest exposures of this mineral. Again, why should such a manufactory have been set up upon a steep hill-side with its approaches of such a character that all the material to be handled, as also the implements fashioned, would have to be transported to and fro, up and down a considerable acclivity? Above all, why should this workshop have been relegated to the bottom of a natural drain, the solid contents of which were necessarily overwhelmed, or swept away bodily, at every considerable rainfall and thaw of the year? As an illustration of the superficial disturbance to which the place was subject, I may mention that at the close of a long but by no means exceptionally protracted rain-storm, I once collected from the notch, by actual count, about one thousand quartzes, all newly plowed out of the soil at that one time. Of this I was certain, as I had previously cleared the ground of every quartz piece of any size within view.

A final fact wholly irreconcilable with the hypothesis of neolithic origin, was the absence of quartzes from the surfaces at the superior edges of the notch, and along the terrace-plain adjoining. It was

not for a moment to be believed that such remains would have been thus distributed by aboriginal artificers. It was simply impossible that the quartz-workers should have limited their manipulations to a strip of sand six or eight feet wide and thirty to forty long, less or more, heaping upon this narrow defile thousands upon thousands of fragments, yet leaving absolutely no small splinters nor chips beyond, neither up the slopes of the notch nor elsewhere in the vicinity.

The above-cited peculiarities of distribution remained the puzzle of the situation until certain of the accumulated objects began to range themselves under types which, though vaguely outlined in touches of extremely rude workmanship, were, nevertheless, distinctly palæolithic in general tone.

The quartzes were now, for the first time, conjecturally classified with the palæolithic implements discovered by Professor Winchell imbedded within the surface of the terrace-plain, and figured in his geological report of a reconnoissance in Morrison county. It was judged that, as had been the case with the Winchell specimens, these objects had been included, primarily, within an upper stratum of the terrace-plain, whence they might easily have been washed by the drainage water copiously discharged through the notch. Such pieces, it was argued, would naturally be stranded near their starting point, yet at a level somewhat below, while the finer enveloping sand associated with them would be carried on and deposited at a more distant spot. It is necessary to keep in view the distinction between *post-glacial* relics and the quartzes found by Professor Winchell. The discoverer holds these latter objects to be essentially a part of the drift of the last glacial epoch, and considers them to have been fashioned prior to the spreading out of the uppermost material of the plain in which they are, at various points, distributed. It goes without saying, that post-glacial remains, on the contrary, are or have been posed upon the face of the drift, and not within its mass. In searching the spot for Indian relics I had confined my attention principally to the surface of the ground; in setting up a quest for palæolithic objects of the class described by Professor Winchell, I examined vertical sections of the upper terrace-plain to a depth of several feet.

Prolonged investigation ensued, establishing the hitherto unsuspected fact that the notch quartzes could never have been

directly involved in the terrace surfaces. Had they once been thus inhumed, the superficial stratum of adjacent drift would assuredly have been found to contain a greater or less proportion of similar fragments, scattered throughout its substance. But this was not the case. On the contrary, no buried quartzes whatever appeared in the superior exposures of the notch, nor within the horizontal surfaces at either hand, though such were sought with careful scrutiny. Since November, 1879, at which time the studies here recorded were in active progress, the wagon-track hitherto mentioned in this paper has been converted to public use as a highway, and has been repeatedly graded in consequence. As might be conjectured, the ground has been much dug over, the stratum being, at present, almost broken up and destroyed, if not wholly so. During three successive seasons, the road has been in a state of almost constant repair, owing to its being continually used for the heavy work of dragging logs from the bottom-land to the top of the terrace-plain. From this and other disturbing causes, not necessary here to specialize, the topography of the spot has been materially modified of late, while quartzes from the bed of the notch, as likewise from the stratum at first discovered, have been much mixed up with the surrounding soil. Primarily, however, as I permit myself to reiterate in the way of emphasis, I could not, with a great deal of painstaking, find any superficially inhumed quartz fragments at the point of observation; although, as shown by Professor Winchell, and as I have myself had abundant occasion to observe, such quartzes occur in the surface stratum of the terrace-plain at various isolated localities in the vicinity. So far as I have been able to judge, these appear in groups which are surrounded by considerable areas containing no observable remains. The absence of chips above a plane a foot or two superior to that of their bed at the bottom of the notch was, of course, a marked circumstance, since they should have occurred plentifully in the superficial stratum, had the notch chips been, as assumed, of the same age with Professor Winchell's find.

Ultimately it was ascertained that the notch quartzes had dropped to the level at which they were first seen, from a thin layer of them, once lying from ten inches to two feet above, and subsequently broken up through the eating out of the sand underneath by drainage, supplemented by the action of wagon-

wheels. This layer or stratum was still intact on the north and south, and partially so on the east, in which direction it had, however, at certain points suffered displacement by wagoning. It extended in what at the time appeared to be a nearly horizontal plane, into the terrace, in the sloping edge of which the notch, opening in the west bank of the terrace and truncated at its edge, is cut. Its outlines, lying within the walls of the notch, were masked against ordinary observation by thin slides of soil from higher surfaces. Both the inferior and superior planes of the quartz bearing stratum were sharply defined. Its horizontal boundaries had not been distinctly reached in any direction at the time of excavating for the road, and they have since been, at least partially, and perhaps wholly, obliterated by the grading and digging over to which the spot has been subjected. At the west the stratum reached to the limit of the terrace, which is here bounded by a steep slope. The quartz-bearing layer averaged a few inches only in thickness, varying a little as the included pieces happened to be of smaller or larger size. The contents were commonly closely compacted, so much so that one might sometimes extract hundreds of fragments, many of them very small ones, of course, from an area of considerably less than a square yard.

The quartz bed, as far as examined, rested upon a few inches of sandy soil which passed downward into a coarse stone rubbish immediately overlying till. Upon the quartzes again, were superimposed drift accumulations extending up to the surface of the terrace. These were characterized, by geological authority, as sand above and sand and gravel below. The pebbles of this gravel were small and well rounded, and were noticeably less angular than those of the rubbish beneath. The stratum of quartzes lay at a level twelve or fifteen feet lower than the plane of the terrace top. The exposed deposit has been found to dip toward the west, and apparently also toward the south; but these inclinations, particularly the former, may be partially or wholly due to the giving way of underlying rubbish. At an early stage of investigation the soil above the quartzes presented to the eye no contrast in color with that of the soil below them. After penetrating some little distance, in a horizontal direction, into the terrace, however, the superior and inferior strata began to show a plain divergence in point of tint, the lower one taking on a dull

yellowish red tinge. After a certain degree of exposure the differential color line fades out, perhaps through the washing into the edges of the excavation of foreign material. Still it has been found to be set up anew at every fresh cutting.

At present everything indicates that these Little Falls quartzes were originally posed upon an ancient surface, since covered by what the glacialists term *modified drift*, now forming all the upper part of the terrace-plain. It will be remembered that the quartz chips and implements discovered by Professor Winchell, in this vicinity, are contained only in the upper stratum of the terrace-plain. Now the notch quartzes do not at all appear at the terrace top, and cannot have been derived from it. They are, on the other hand, confined strictly to a single thin stratum of the lower gravels closely overlying till, and sometimes, perhaps, merging into it on the west, as hereafter explained. Hence the two sets of objects cannot be synchronals, though they may have been produced by the same race at different stages of its existence. The notch quartzes must of course be older than those of the superior stratum of drift by at least the lapse of time required for forming and draining the deposit lying between the quartzes below and those above.

Professor Chamberlin, State geologist of Wisconsin, in treating of the ancient vegetal deposits of his district, precisely indicates what at the present moment appears to be the glacial position of the Little Falls quartz stratum. Speaking of the Kettle moraine of Wisconsin, which is continuous with the northeast moraine of this region, he says:

"Some of these organic strata lie at the immediate foot of the moraine beneath fluviatile and lacustrine deposits that, I am confident, began to be accumulated during the accumulation of the moraine and through the agency of glacial floods."

The observations recorded above are offered in their present form as a special answer to inquiries and suggestions propounded to the writer, from time to time, by archæological investigators. They are likewise adduced as evidence that the theory of an ancient quartz-paved surface is not the result of a mere hasty guess, but is, on the contrary, the slow outgrowth of many particular observations and deductions. Certain of these, however, remain yet to be stated. The facts above given will, it is hoped, plainly illustrate the successive steps by which the present

working hypothesis has been reached. They are arranged to show:

First; why the notch quartzes are not attributed to natural causes now operating upon the present surface.

Second; why these objects are not ascribed to modern races once inhabiting the region.

Third; why they are not classed with the implements previously unearthed at Little Falls by Professor Winchell.

Fourth; why they are referred to a palæolithic people once inhabiting an ancient till surface, which is at present buried beneath a sheet of modified drift. Of this, however, more hereafter.

At present, palæolithic remains are assigned to three distinct eras:

The *preglacial*, or anteglacial, including geological time wholly preceding the ice epochs.

The *interglacial*, time between any two of these epochs.

The *intraglacial*, time during such an epoch.

According to the generalization of Geikie, adopted in this paper, *postglacial* relics, however rude they may be, are not truly palæolithic, although they may be popularly reckoned as such.

It is not possible that the notch quartzes belong to the first of these palæolithic classes. They cannot be preglacial because they are based upon till, a deposit which is universally acceded to be a ground moraine, formed, in some way, at the bottom of a glacier, and left behind when the glacier withdraws. In the present case the underlying till must not only have been laid down, but must likewise have been permanently uncovered by the recession of the producing ice, before the quartz-workers could at all have gained access to it, much less have set up their primitive industries upon its surface. These objects are furthermore clearly not postglacial, because they lie under a sheet of modified drift, fifteen feet and less in thickness, which has certainly been produced in one way or another by dissolving glaciers.

The question whether the quartz deposit is intraglacial or interglacial in origin is one which is not so readily answered in the present state of our knowledge. Indeed, it may very well be both perhaps; that is, it may have had a beginning prior to the final advance of the northeast and northwest glaciers, and then have continued to exist, and to receive accretions from time to time, up to a period during the second ice age when these glaciers

were in process of final liquefaction. Certain elements of the geological situation recently developed by American scientists, and already touched upon in this paper, necessarily enter as essential factors into the solution of the problem before us. The following is a summarized recapitulation of glacial principles enunciated by authorities now engaged in deciphering the ice chronicles of the Northwest:

That this whole region has been subjected to a period or periods of glaciation antedating the last.

That a longer or shorter era of deglaciation, known to scientists as an interglacial epoch, intervened between the deposit of the older tills and the readvance of the northeast and northwest glaciers during the latest ice period.

That the general direction of glaciation was similar during the earlier and later ice epochs, though it was not always precisely the same.

That glaciation was far more extended in its range at the former of these periods than at the latter; the ice of the former having stretched fully three hundred miles south of the termini of the modern morainic lobes.

That the modern morainic belt defines the limit of extension of the glaciers during the last ice epoch.

Finally, that the Little Falls quartz stratum lies between the modern moraines of the northeast and northwest glaciers, in a medial morainic belt which is characterized by a system of overlapping tills, as described in Mr. Upham's paper at the close of this article.

The above elements sum up the glacial situation as understood by specialists, so far as concerns the quartz stratum under consideration. The tills of Morrison county have, up to the present time, not been fully reported upon, and their special interrelations are accordingly very imperfectly understood.

(To be continued.)

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THE GENESIS OF CRYSTALLINE ROCKS.[1]

BY T. STERRY HUNT, LL.D., F.R.S.

THE writer began by an account of the various hypotheses hitherto proposed to explain the origin of the ancient crystalline stratified rocks, of which gneiss may be taken as the type,

[1] Abstract of a paper read before The National Academy of Sciences, April 15, 1884.

(1.) The *plutonic* hypothesis, which conceives the rocks in question to have been formed by the superficial cooling of a molten globe before the precipitation of water upon its surface. (2.) The *volcanic* hypothesis, which supposes them to be derived from igneous rocks, like lavas, coming from a liquid interior through the primitive crust. (3.) The detrital or *clastic* hypothesis, which conceives them to have been made of the ruins of plutonic or volcanic rocks, more or less disintegrated or decayed, rearranged by water, and subsequently modified by chemical changes. Similar alterations, through subsequent action of water, are also invoked by the advocates of the plutonic and volcanic hypotheses. (4.) The *chaotic* hypothesis, which supposes the elements of all these rocks to have been at one time dissolved or suspended in the water of a primitive chaotic ocean.

The difficulties in the way of accepting any one of these hypotheses being pointed out, it was shown that the rocks in question include a number of well-marked and lithologically distinct groups, each of great thickness, giving evidences of successive depositions interrupted by foldings and erosions, and extending over vast periods of eozoic time. The new hypothesis proposed by the writer to explain the origin of these rocks, unlike the first three named, starts from the basis of a solid earth. The globe consolidating at the center, left, it is conceived, a superficial layer of basic silicates, which has yielded all the fixed elements of the earth's crust. This layer formed the first land and the floor of the primeval sea, the acid waters of which, permeating and partially decomposing it, became thereby chemically neutralized. This last-cooled layer, mechanically disintegrated, saturated with water, and heated by the central mass, was the source of mineral springs holding in solution the silicates which built up the ancient gneisses and similar rocks.

This hypothesis of their origin was illustrated by the history of granitic veins, and by the derivation of quartz and orthoclase, and of zeolites (which are hydrated feldspars) by aqueous action from basic rocks. All such deposits are due to survivals of the process which generated the gneissic rocks. The hypothesis of their formation from materials brought to the surface by mineral springs from the primitive basic layer, affords, it was claimed, the elements of a complete and intelligible explanation of the origin of the eozoic rocks, and was first suggested by the

writer in 1874 (Chemical and Geological Essays, pp. 298, 299). It may be conveniently designated as the *crenitic* hypothesis (from the Greek κρηνίτης, pertaining to springs or fountains). All veinstones and deposits from mineral springs are of crenitic origin.

It was farther shown that the upward lixiviation of the primitive mass, and the deposition over it of an acidic granite-like rock would leave below a highly basic material, and that the division of the mass thus established would correspond to that of the trachytic and doleritic magmas which have been conjectured to be the sources of two great types of eruptive rocks. Inasmuch, however, as according to the present hypothesis these two layers of basic and acidic matters are the results of aqueous action, and not of an original separation in a plutonic mass, as imagined by Phillips and Durocher, their composition would be subject to many local variations. The secondary origin of the materials of eruptive rocks has long been maintained by the writer, who finds the source of certain of them in the underlying basic layer left by the partial solution of the primitive mass; which now forms, it is believed, a plastic stratum between the solid anhydrous nucleus and the solid crust.

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EDITORS' TABLE.

EDITORS A. S. PACKARD, JR., AND E. D. COPE.

—— Professor A. Weisman, who has recently published a brochure on inheritance, and another on the duration of life, has now attacked from the biological, *i.e.* inductive point of view, those ultimate problems which so often arise in the minds of thoughtful men, What is life and death? His tract was when first read as an academic programme, entitled "On the Perpetuity of Life." It is claimed by the author that in the protozoa, or one-celled animals, we cannot speak of a natural death in connection with these lowest organisms, for there is no observable end to their phases of development which is comparable to the death of the higher, many-celled animals. In the protozoa there is no origin of new individuals resulting in the death of the parent, but as seen in the self-division of any infusorian, neither of the new individuals is the older or younger. Thus there arises an unending series of individuals, each one of which is as old as the species itself, each

one having the capacity of an unlimitable existence and of undergoing an indefinite number of fresh acts of self-division.

That the higher organisms, or the many-celled animals have not this power, Weismann thinks, is owing to their multicellular structure, and to the division of labor between the cells of their bodies.

The essay is certainly a very suggestive one, as is indeed nearly all of Weismann's work. The space at our command only permits us to give the author's conclusions:

1. Natural death alone occurs in many-celled organisms, the one-celled forms do not possess it; the process of encysting of the latter is in no wise comparable to death.

2. Natural death appears to first occur in the lowest Metazoa, *i.e.* the Orthonectides, through the adjustment (normirung) of the cells collectively in one generation, and of the somatic or peculiarly body-cells in a limited existence; then also in the higher Metazoa the somatic cells adjust themselves first to several, and then many generations, and thus are correlated with or adjusted to an extended existence.

3. This adjustment goes hand in hand with the differentiation of the cells of the organism according to the principle of division of labor in reproductive and in body-cells, and was accomplished by a process of selection.

4. The biogenetic fundamental law applies only to the many-celled beings, but has no application to the unicellular forms; this also bears a relation on the one hand to reproduction through division in the monoplastids (one-celled forms), on the other on the necessity through sexual reproduction of the relation of a one-celled developmental stage in the polyplastids (many celled).

5. As in death itself, so also the shorter or longer duration of life is solely a matter of adaptation; death is not dependent on a primitive quality of living matter; it also is not especially connected with reproduction, nor is it indeed a necessary consequence of the same.

Finally, our author maintains that life is a perennial, not a periodically interrupted state. When first introduced on the earth it went on without interruption; only its forms changed, and the individuals of all, even the highest forms, which are living to-day, have descended in unbroken continuity from the oldest primæval forms; there is a complete continuity of life.

—— The study of these problems, we would add, will tend to throw light on the life and death of species, of genera, families and orders of plants and animals.

At present the causes of the extinction of the life of species and higher categories are interwoven with those of the origin of species. To say that species like individuals have their appointed time is a mere platitude. It is now beginning to be understood that geological extinction was due mainly to changes of land and water in the growing continents, and to consequent lack of adaptation to the new conditions on the part of those organisms which were unsuccessful in the struggle for existence. Thus the apparent lack of continuity in a part of the life which stocked the earth in former ages was due to the lack of adaptation. But life as a whole has always been continuous, perennial; the breaks were the result of more or less local breaches of continuity in the continent-making processes. The youth, maturity and senility of individuals is, as Hyatt has shown, paralled by the youth, maturity and decline of the types to which they belong; and we can now begin to see how correlated and continuous are the phases of what we call life and death in the material world, and throughout all time, and all forms of life.

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RECENT LITERATURE.

BRAUER'S STUDIES ON DIPTEROUS LARVÆ.[1]—This is a most valuable addition to our knowledge of the early stages of the Diptera, and is the result of a large acquaintance with the early forms of this order, by one who has for over twenty years devoted special attention to these insects. In his "Monographie der Œstriden," 1865, but more especially in his "Kurze Characteristik der Dipteren-larven," 1869, wide gaps in our knowledge of the transformations of the Diptera were filled. And now with the present work, in addition to the observations of the earlier entomologists, and the recent writings of Fritz Müller, Dewitz and Wierzejski on the transformations of the Blepharoceridæ, and of Handlirsch on the Nemestrinidæ, we are in possession of a knowledge of the larval stages of one or more species of all the natural families of Diptera. After lengthy remarks on the systematic relations of different groups of Diptera, based on the larval characters, Brauer states that the typical, inherited feature in the entire group of Dipterous larvæ appears to be the position of the brain (kopfganglien), whether it is contained in a head-capsule, or free, *i. e.*, far behind the mouth or immediately behind the chitinous cap-

[1] *Die Zweiflügler des Kaiserlichen Museums zu Wien.* III. Systematische studien auf Grundlage der Dipteren-larven nebst einer zusammenstellung von Beispielen aus der Literatur über dieselben und beschreibung neuer Formen. Von Prof. Dr. Friedrich Brauer. Mit 5 Tafeln. Besonders abgedruct aus dem XLVII Bande de Bande. Math.-Naturw. Cl. k. Akad. der Wissensch. Wien, 1883. 4to, pp. 100.

sule (kiefer-kapsel), supporting some of the mouth-parts, and containing the œsophagus. Less important characteristics are then enumerated. A very unsafe character is the number of visible body-segments, since in some they are often not true segments, but intermediate rings arising from the lengthening of the membrane connecting the true segments (Polytoma); in others a secondary annulation of the single segments, whose true limits in the living animal can be best determined by the markings repeated on the true segments (Ceraplatus); or they appear to be reduced in number through the coalescence of the anterior or hinder segments (Blepharocera, Liponeura, Culex, Simulium, etc.); or any external segmentation is almost wholly wanting (Eristalis, Microdon, etc.).

Thus we may count in the Polytomous larvæ behind the maxillary capsule (we do not know how better to translate *kiefer kapsel*) 20–21 segments; in the Cecidomyid larvæ 13 segments; in the Tabanidæ and Stratiomyidæ 11 segments; in the Leptidæ 11–12; in the Tipulidæ 12, as also in the Asilidæ, Nemestrinidæ and in the Muscidæ.

"In the Muscidæ, Æstridæ, etc., the larval body is regarded as 12-segmented. This is based on the view that the antennal segment enclosing the mandible (mundhaken), which in all the cyclorrhaphous larvæ remains membranous, while in the Orthorrapha (except Lonchoptera) it is above firm and chitinous, forming a ring bearing the antennæ and jaws, which we have termed the kiefer-kapsel. On the other hand the cyclorrhaphous larvæ have, behind the antennal-bearing segment, only eleven true segments—three thoracic and eight abdominal segments. The first or antennal segment must especially be regarded as complex, since it encloses the kiefer-kapsel and bears the antennæ. As to the disappearance of a ninth abdominal segment, which is distinct in some larvæ, the embryonic development must give the clue, though the terminal segment in a good many forms is plainly formed of two segments (Blepharoceridæ, etc.)."

While the view as to the head-segments is a practical one, and of value from a systematic point of view, we wonder that Dr. Brauer has not adopted the broad morphological view, based on the well-known facts in the embryology of Diptera, that the head of any dipterous insect is at first, like that of other insects, composed of four segments, *i. e.*, an antennal, mandibular, first maxillary and second maxillary; the peculiar modification in the dipterous larvæ being the result of degradation; the adaptation of form and structure in these larvæ to their varying surroundings being very marked. It seems to us that the larvæ of Eucephala (Chironomus, etc.) represent the primitive form of dipterous larvæ, the headless forms, or maggots, being the result of adaptation. It was, however, Dr. Brauer's intention not to enter into these questions in the present essay, but simply to de-

scribe them for the practical needs of the entomologist. The homologies of the larval mouth-parts with those of other insects he does not discuss, though he apparently does not consider them to show such homologies; though Weismann regarded the mouth-parts of the muscid and other larvæ to be consolidated mandibles.

Brauer then lays down the characters of the dipterous larvæ in general, and discusses the value of the larval characters in classification. We have no space to condense the statements as to the characteristics of the metamorphosis of the different groups, or to present the convenient tabular view on p. 11. We note, in passing, that Dr. Brauer makes no reference to the Pulicidæ, which he evidently does not consider as Diptera; but with larvæ so closely resembling the encephalous larvæ (Mycetophilidæ), we do not see how some discussion of their affinities or even structure could well have been avoided in an essay of the scope of the present one.

Then follows a lengthy and interesting tabular view of the nervous systems of the larval as compared with the adult Diptera. This is succeeded by a section on the characters of the sub-orders and families; this occupies the greater part of the work, and is of prime importance. It is followed by short descriptions of a few larvæ of the families Tabanidæ, Leptidæ, Dolichopidæ and Empidæ.

The systematic list of descriptions of known dipterous larvæ with the bibliographical references (pp. 46–93), will be of the greatest use, especially to American entomologists; its compilation was a laborious undertaking; it appears to be very full and accurate, though we notice the omission of any reference to the description and figures of *Chironomus oceanicus* Pack., but such omissions must be few. The full index to the genera is a valuable feature. The plates, like all the author's artistic work, are excellent.

The Diptera are, without doubt, the most difficult order of insects, and Dr. Brauer, in giving us these results of ten years' labor on their larval forms, has laid entomologists under lasting obligations. The work will be of value to the systematist as well as to the economic entomologist, while the general biologist will find it a storehouse of facts bearing on the evolutionary problems of the day.

DeCandolle's Origin of Cultivated Plants.[1]—The aim of the author in this work has been to inquire into the condition and habitat of each species before becoming cultivated. Over how wide a range of inquiry, antiquarian, historical and botanical this has led the learned author, may be seen by glancing over the

[1] *Origin des Plantes cultivées.* Par Alph. DeCandolle. Bibliotheque scientifique internationale, xliii. Paris, 1883. 12mo, pp. 378.

footnotes. The number of cultivated species mentioned amounts to 249, but the author adds that by the end of this century there will be about 300 species out of 120,000 or 140,000 species of the vegetable kingdom; but this is more than in the animal kingdom, where out of "some millions" [*sic*] of species there are only 200 species of domestic animals.

The author remarks in the opening chapter that selection—that great factor that Darwin has had the merit of so happily introducing into science—plays an important rôle in agriculture once established; but at every epoch, and especially in the beginning, *the choice of species has more importance than the selection of varieties.* As to the earliest beginnings of the culture of useful plants in temperate Europe and Asia, the following extracts are of interest:

"In spite of the obscurity of the commencement of culture in each region, it is certain that the earliest date of cultivated plants is very different. One of the oldest examples of cultivated plants is, in Egypt, a drawing representing the fig, in the pyramid of Gizeh. The epoch of the construction of this monument is uncertain. Authors have varied between 1500 and 4200 years before the Christian era! If we suppose it to be about 2000 years, it will be an actual antiquity of 4000 years. But the construction of the pyramids could only have been carried on by a numerous people, organized and civilized up to a certain point, having, consequently, an established agriculture, which should make the antiquity much higher, at least some centuries.

"In China, 2700 years before Christ, the emperor, Chen-nung, instituted the ceremony in which each year he sowed five kinds of useful plants: rice, soja, wheat and two kinds of millet. These plants must have been cultivated for some time, in certain localities, to have attracted the attention of the emperor. Agriculture appears, then, to have been as ancient in China as in Egypt. The constant relations of this last country with Mesopotamia lead us to suppose the existence of a culture almost contemporaneous in the regions of the Euphrates and of the Nile.

"Why should it not have been as ancient in India and in the Indian archipelago? The history of the Dravidian and Malayan peoples does not go back very far, and presents some obscurity, but there is no reason to believe that agriculture did not begin among them a long time since, particularly on the borders of rivers.

"The ancient Egyptians and the Phœnicians have propagated many plants in the region of the Mediterranean, and the Aryan peoples, whose migrations toward Europe commenced somewhere near 2500, or at least 2000 years B. C., have spread about several species which were already cultivated in Western Asia. We shall see, in studying the history of some species, that already certain plants were probably cultivated in Europe and in the north

of Africa. There are some words of languages anterior to the Aryan, for example, Finnish, Basque, Berber and Guanch (of the Canary isles), which point to this conclusion. As to the remains called Kjokken möddings, the ancient stations in Denmark have furnished no proofs of the existence of agriculture, and likewise no proof of the possession of any metal. The Scandinavians of this epoch lived principally on fish, game and perhaps incidentally indigenous plants, like the cabbage, which are not of a nature to leave any traces in refuse or rubbish heaps, and which might have passed into cultivation. The absence of metals does not presuppose, in this northern country, an antiquity greater than the age of Pericles, or even of the prosperous period of the Roman republic. Afterward when bronze became known in Sweden, a region far removed from the civilized world, agriculture was completed by its introduction. There are found in remains of this epoch the carving of a plough drawn by two oxen and driven by a man.

"The ancient inhabitants of Eastern Switzerland, where they had instruments of stone and not of metal, cultivated several plants, some of which were natives of Asia. M. Heer has shown in his admirable work on the palafittes (lake-dwellings) that they had communication with the countries situated among the Alps. They could also have received cultivated plants through the Iberians, who occupied Gaul before the Celts. At the epoch when the lake-dwellers of Switzerland and of Savoy possessed bronze, their husbandry was more varied. It seems also that the lake-dwellers of Italy, when they had this metal, had a smaller number of species under cultivation than those of the lakes of Savoy, either from their higher antiquity or from local circumstances. The remains of the lake-dwellings of Laybock and of Mondsee, indicate a quite primitive agriculture—no cereals at Laybock and a single grain of wheat at Mondsee. The slightly advanced state of agriculture in this eastern part of Europe is opposed to the hypothesis, based on some statements of the ancient historians, that the Aryans had first sojourned in the region of the Danube, and that Thrace was civilized before Greece. In spite of this instance agriculture appears, in general, to have been more ancient in the temperate portion of Europe than we would be led to believe by the Greeks, who were disposed, like certain moderns, to make all progress originate from their own nation."

The first chapter of Part I treats of how and at what epochs the culture began in different countries; the preceding extracts are from this chapter. In the second chapter the author concludes that in order to ascertain the origin of the cultivated species, we should combine botanical, archæological, palæontological, historical and linguistic methods.

The second part comprises most of the volume, and treats of the origin of those plants cultivated for their racemes, bulbs or

tubers; those cultivated for their stalks or leaves; those useful from their flowers or the parts enveloping them; fruits and grains. The third part is devoted to a résumé and conclusions, with valuable statistics.

The work is, of course, authoritative and is, moreover, exceedingly interesting. With it should be read the lengthy review of the work, by Dr. Asa Gray and J. Hammond Trumbull, in the *American Journal of Science* for April and May, 1883, containing valuable additions relative chiefly to American plants.

JACKSON'S VEGETABLE TECHNOLOGY.[1]—This is evidently a most carefully prepared bibliography of economic botany, and must prove of great utility. The author purposely excluded all books devoted to silk and cochineal, as not being strictly within the limits of the title as settled by the Index Society; and "most reluctantly the subject of the vine, its culture and products, simply on the ground of its enormous extent." The bibliography of the vine, he adds, in all its bearings would require a lifetime for its compilation. He has also excluded books and papers of simply horticultural, therapeutic, chemical, commercial or manufacturing interests, unless they contained a sufficient account of the raw products, its cultivation or whence obtained to justify their citation. The author does not claim that the work is complete, saying that "a complete bibliography of economic botany would require the labor of years." The number of entries in the present book is 3580, exclusive of translations and different editions. The index fills nearly 100 pages, is comprehensive, and adds greatly, of course, to the usefulness of the work.

SMITH'S DICTIONARY OF ECONOMIC PLANTS.[2]—The scope of this work is sufficiently indicated by the title; it is not confined to the cultivated plants. The author was officially connected, for more than forty years, with the Kew Gardens, and was thus practically acquainted with the largest collection of living plants, exotic and native, ever brought together. In regard to those points which DeCandolle has worked out with such care, the present work is deficient, still it is a useful book, arranged in the form of an index or dictionary.

RECENT BOOKS AND PAMPHLETS.

Engelmann, Geo.—The mean and extreme daily temperature in St. Louis for forty-seven years, as calculated from daily observations. Ext. Trans. St. Louis Acad. Sci., Vol. IV, 1884. From F. E. Nipher.

Nipher, F. E.—On the expression of electrical resistance in terms of a velocity. Ext. Trans. St. Louis Acad. of Science, Vol. IV, 1884. From the author.

[1] *Vegetable Technology.* A contribution towards a bibliography of economic botany, with a comprehensive subject-index. By BENJAMIN DAYDON JACKSON. Founded upon the collections of George James Symonds. London, published for the Index Society. 1882. 8vo, pp. 355.

[2] *A Dictionary of popular names of the Plants which furnish the natural and acquired wants of man in all matters of domestic and general economy. Their history, products and uses.* By JOHN SMITH. London, Macmillan & Co. 1882. 8vo, pp. 457.

Barrois, Chas.—Memoire sur les Schistes Metamorphiques de l'ile de Croix (Morbihan). Ext. des Ann. de la Soc. Geol. du Nord, Lille.

——Memoire sur les Dictyospongidæ des Psammites du Condroz. Ext. idem. Both from the author.

Lydekker, R.—Palæontologica Indica, Ser. X, Vol. III, Part I. Additional Siwalik Perissodactyla and Proboscidea. Calcutta. 1884. From the author.

——Synopsis of the fossil Vertebrata of India, and note on the Bijori Labyrinthodont. From the author.

Cook, G. H.—Annual report of the State Geologist of New Jersey for 1883. Camden, 1883. From the State geologist.

Loring, G. B.—Report of the Commissioner of Agriculture for 1883. Washington, 1883. From the Commissioner.

Vaillant, Leon.—Exposition Univ. Internat. 1878. Rapports du Jury International. Les Poissons, Crustacés et Mollusques. Paris, 1880.

——Remarque sur les affinités naturelles de Poissons Malacopterygiens Abdominaux.

——Sur le genre Ptychogaster (Pomel), Chelonien fossile de Saint-Gerand-le-Puy.

——Nouvelles Archives du Museum D'Histoire Naturelle. Notice sur la Grande Salamandre du Japan, *Cryptobranchus japonicus* V. D. Hoeven.

——Note sur les Exemplaires du Bagrus Buchanani provenant du voyage de V. Jacquemont. Ext. Bull. de la Soc. Philome. de Paris, 1882.

Vaillant, Leon, et Bocourt.—Mission scientifique au Mexique et dans L'Amerique Centrale. 4me Partie. Etudes sur les Poissons. Paris, 1883. All from Leon Vaillant.

Allen, Alf., et al.—Journal of Microscopy and Natural Science, April, 1884.

Whitfield, R. P.—Notice of some new species of primordial fossils in the collections of the Museum of Nat. Hist. N. Y. Ext. Bulletin of the Amer. Mus.

Hitchcock C. H.—Geological sections across New Hampshire and Vermont. Ext. Bulletin of the Amer. Mus. Both from the Amer. Mus. N. Y.

Scudder, S. H.—Two new and diverse types of Carboniferous Myriapods.

——The species of Mylacris, a Carboniferous genus of Cockroaches. Both in memoirs of the Boston Society Nat. Hist., Vol. III, No. IX. From the author.

Parker, W. K.—On the skeleton of the Marsipobranch Fishes. Part I. The Myxinoids (Myxine and Bdellostoma). Part II. Petromyzon. Ext. Philos. Trans. Royal Soc., Part II, 1883. From the author.

——On the structure and development of the skull in the Crocodilia. Ext. Trans. Zool. Soc., Vol XI, Part IX, 1883. From the author,

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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On the Fossil Flora of Greenland.—Through Professor O. Heer's researches, 617 species of fossil plants are now known from Greenland, of which 335 belong to the Cretaceous and 282 to the Tertiary epoch. The Cretaceous plants occur in three distinct stages, described as the beds of Kome, Atane and Patort.

In the *Kome beds* vascular Cryptogamia (especially *Gleicheniæ*) and Gymnosperms (namely, ten Cycadeæ, forms analogous to the *Zamiæ*, and twenty-one Conifers, including five Sequoiæ) are found almost exclusively. The Dicotyledoneæ are represented only by a single species, *Populus primaeva*. The general character of the flora of these deposits, which may be compared with the Urgonian strata, indicates a subtropical climate.

In the *Atane beds* there occur, besides vascular Cryptogamia (some of which are arborescent) and Gymnosperms (eight Cycadeæ, twenty-seven Conifers; among others *Cycas steenstrupi* with well-developed carpels), ninety species of dicotyledoneæ, the appearance of which was very sudden. Here, also, the flora indicates a subtropical climate. The Atane beds may be compared with the Cenomanian strata.

In the *Patort beds*, twenty vascular Cryptogamia, eighteen Gymnosperms, five Monoctyledoneæ, and sixty six Dicotyledoneæ have been found. Among the Conifers the most abundant species is *Sequoia concinna* Heer (branches and fruits), nearly related to the Tertiary *Sequoia couttsiæ; Sequoia langsdorfii* Brgr., a Tertiary species, is also frequently met with. The Dicotyledons consist of birches, alders, elms, fig-trees, walnuts, oaks and planes (the last two genera in great numbers); then come laurels, cinnamons, azalias, magnolias, &c., &c. The Patort beds also contain marine animals, which enable us to make an exact comparison with the deposits of other countries, and approximate them to the Upper Senonian of Europe, consequently to the Upper Chalk.

The Tertiary flora of Greenland is derived either from an Eocene deposit or from Lower Miocene beds. It includes in all 282 species, two of which also appear in the Chalk; twenty others are derived from Cretaceous plants, but the rest show no relationship to the Cretaceous flora. Moreover, tropical forms are entirely wanting, so that the climate had been profoundly modified; the mean temperature of the year in Greenland at the epoch of the Lower Miocene must have been about 12° C. (= 53° ·6 F.), as evidenced by the presence of two fan-palms, magnolia, Sapindus, Dalbergia, &c. The Tertiary flora of Greenland has 114 species like those of Europe.—*Bibl. Univ., Arch. des Sci. October 15th, 1883, p. 355.*

Geological Notes.—*General.*— MM. Mojsisovics and Neumayr (Beitr. z. Palæont. Ost. Ungarns, 1883) describe the trilobites of Bohemia.

Cambrian and Silurian.—W. Dames describes (Richthofen's China, Palæontology) fifteen species of trilobites from the Cambrian of Liau-Tung, near the Corean boundary. E. Kayser (*op. cit.*) describes a few Cambrian Brachiopoda from Liau-Tung, and adds several new species to the fossils of the Middle and Upper Silurian of the mountains of Tshau-tien. In the same work G. Lindström describes numerous species of corals from the Upper Silurian of Tshau-tien.——J. F. Whiteaves has described numerous fossils from a series of dolomites that lie between the Niagara and Onondaga formations, and are known in Canada as the "Guelph formation." The species include three corals, three brachiopods, sixteen lamellibranchs, two gasteropods and a trilobite that are new to science.

Devonian.—M. D. Œlhert (Bull. de la Soc. Geol. de France) describes four species of Chonetes known from the Devonian of

the west of France, and discusses the relationships of the genus. The same geologist also describes two new species of Acrocutia, *A. protei* and *A. sileni*, from the Lower Devonian of Mayenne. ——E. Kayser (Richthofen's China) describes fourteen species of Devonian brachiopoda from Southwest China. Fourteen species of fossils were previously known from the Chinese Devonian.

Carboniferous.—C. Schwager (Richthofen's China) describes the flora of the Carboniferous strata of China and Japan.——E. Kayser (*op. cit.*) describes the collection of Upper Carboniferous fossils made by Baron Richthofen at Lo-Ping. This consisted of 1000 specimens and over fifty species, including *Leptodus richthofeni*, a new genus and species of fishes, *Phillipsia obtusicauda*, four nautili, two or three Orthoceratidæ and numerous lamellibranchs and brachiopods.

Jurassic.— M. Sauvage (*loc. cit.*) describes the fishes of the genus Pleuropholis, with the following new species, *P. egertoni*, *P. thiolleri*, *P. obtusirostris*, *P. lienardi*. The genus was first known from the Purbeck beds of England, and has since been found in the Lower Kimmeridge of Cervin, France.——M. P. J. Van Beneden (Bull. de l'Acad. Roy. de Belg.), has a note upon some cetacean bones, consisting of four vertebræ and two fragments of ribs, found in the Oligocene phosphatic beds between the Elbe and the Weser. He determines these bones to belong to two species of whalebone whales, of which the larger, *Pachycetus robustus*, was equal in size to *Balænoptera rostrata*, while the smaller, *P. humilis*, equaled *B. juddi*. With these cetacean remains occurred the sternebra of a great terrestrial mammal, probably that of *Lophiodon rhinoceroides* Geinitz. The same beds yield numerous mollusks and teeth and vertebræ of plagiostomes. The latter had been referred to *Lamna cuspidata*, *L. elegans* and *Myliobates dixoni*.—A. Locard (Arch. Mus. d'Hist. Nat. de Lyon, 1883), describes the Pliocene fresh-water shells of the basins of Lakes Tiberias, Antioch and Homs, seventy-one species in all, mostly new. Twenty-nine belong to Unio, thirteen to Limnæa and nine to Melanopsis. Melania and Dreissena are each represented by two species, Planorbis by one.

Tertiary.—L'Abbé Bazin (Bull. de la Soc. Geol. de France, 1883), has described the Echini of the middle Miocene of Brittany. The new species are *Echinocyamus lebescontei*, *Scutella circularis*, *Nucleolites dinanensis*, *Echinanthus armoricus*, *Echinolampas dinanensis*, *Brissus humberti* and *Spatangus brittannus*.——Palæontologica Indica, series x, volume II, part 6, treats of the Siwalik and Narbada Carnivora. *Mellivora sivalensis* is known from three specimens obtained near the Ganges valley, while another ratel occurs in the Punjab. *Mellivorodon palæindicus* was intermediate in size between the ratel and the glutton, but probably more nearly allied to the former. Mr. Lydekker unites under Lutra several of Gray's genera, and adds to the already numerous recent and extinct

species *Lutra bathygnathius.* To the bears he adds *Ursus theobaldi,* which may probably be the ancestor of the aswail (*U. labiatus*), but had better developed molars. *Hyænarctos punjabensis* and *H. palæindicus* are considered to be distinct from *H. sivalensis; Amphicyon palæindicus* is added to the Canidæ and *Viverra durandi,* the largest known civet, to the Viverrideæ; *Hyæna colvini* is separated from *H. sivalensis,* and is said to approach Crocuta, and *H. macrostoma* constitutes an important link between the more typical members of the genus and the viverroid and canoid Carnivora. To the Felidæ are added *Æluropsis annectans,* and *Felis brachygnathus* and the occurrence of a hyænodon (*H. indicus*) in the Siwaliks is mentioned as a matter of extreme interest.——M. Lemoine (Bull. de la Soc. Geol. de France, 1883), describes *Neoplagiaulax eocenus* and *N. marshii,* from the Lower Eocene near Rheims. The genus is distinguished from Plagiaulax by the presence of a single premolar only on each side. M. Lemoine considers it as intermediate between Plagiaulax and the recent Bettongia.

MINERALOGY.[1]

Native Iron from New Jersey.—As a deep well was being bored on the Van Horn farm, in Raritan township, Middlesex county, N. J., about three miles east of New Brunswick, in Triassic red shale, it was noticed that when the drill was raised from the well there were numerous particles and small grains of iron adhering to its lower end. This attracted the attention of Mr. J. F. Hotchkiss, of Plainfield, who found that particles of native iron occurred not only in the well, but in the surface earth about the farm.

An analysis of an unwashed sample gave J. B. Stillman:

Iron	Phosphorus	Sulphur	Silica	Titanic acid
76.12	0.27	1.23	11.20	0.21

Professor Cook also made repeated visits to the farm and picked out particles of metallic iron with a magnet, being satisfied that there was no mistake or deception in the case.

He states[2] that while a few of the grains are as large as pin heads, most of them are smaller and much is fine dust. Some of those brought up by the drill are but little oxidized on the surface, while those found in the soil are rusted, often so completely as to leave only a small particle of metallic iron in the center of the rusted grains. The metal flattens under the hammer, and is evidently native. Traces of copper are reported to occur in the iron.

The observation is of great interest. It is now well known that metallic iron occurs in trap, but its discovery in a sedimentary

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Geolog. Survey of N. J., Annual Report for 1883, p. 162.

shale introduces new considerations. It may have been reduced by organic substances, as supposed by Hausman and Karsten in the case of certain analogous instances in Germany, or it may have been washed out of a trap dyke, or again it may be the result of meteoric action in Triassic times. Being found at a depth of fifty feet in the red shale, it cannot belong to the drift, but is evidently of Triassic age. The subject is very suggestive.

FLEXIBLE SANDSTONE FROM PENNSYLVANIA. — H. C. Lewis[1] records the finding of itacolumite, or flexible sandstone, at two localities in Pennsylvania, in Paradise township, Lancaster county, at the "Wolf rocks," and in White Marsh township, Montgomery county, north of Lafayette. In both localities the flexibility, which is much less than in the North Carolina rock, is evidently due to the decomposition of the cementing material in a formerly inflexible sandstone. By the removal of the feldspar each thin layer of sand is separated by small distances from the layers above and below, thus allowing of limited flexibility. This explanation probably applies to all flexible sandstones. The "ball-and-socket" theory of the grains of sand is of course absurd.

SOME MAINE MINERALS.—G. F. Kunz[2] states that nearly 1500 crystals of tourmaline have been obtained from "Mount Apatite," near Auburn, Maine. These are often brilliantly polished, and are characterized by their beautiful pale color. Colorless, light pink, light blue, bluish-pink, pale green and other colors occur in different crystals or are sometimes nearly all seen in a single tourmaline. Good gems have been cut from these crystals.

The apatite of the same locality is finer in color and form than elsewhere in America. It has the same pale shades of pink, blue, purple and green as the tourmaline found with it, and has been set for gems.

Other associated minerals are lepidolite, quartz, albite, orthoclase, beryl, garnet, cassiterite, gummite, autunite, muscovite, leucopyrite, cookeite, biotite, amblygonite and zircon.

At Gorham some unusually fine crystals of andalusite have been found. The color is mostly a brownish flesh tint, and sometimes grayish-pink. Occasional translucent pieces occur in the nearly opaque crystals.

The interesting fact was observed that while the hardness on the side of the prism is 6–6.5, the hardness on the basal plane is 7.5. The crystals occur in a quartzite vein in a brown mica schist, in which are small crystals of pyrrhotite.

NATURAL NITROUS OXIDE, OR LAUGHING GAS.—It is stated[3] that "the great Sierra tunnel, at Tioga, has developed the presence, in the indurated mudstone, silicious limestone and arena-

[1] Proc. Acad. Nat. Sciences Phila., 1884.
[2] *Amer. Jour. Science*, April, 1884.
[3] *Lundy* (California) *Index*.

ceous shales of Tioga hill, of protoxide of nitrogen, the exhilarating gas known as 'laughing gas,' with traces, also, of the nitrates commonly associated with several of the metals. As is well known, the inhalation of protoxide of nitrogen produces exhilaration to intoxication, an irresistible impulse to muscular exertion, insensibility to pain, and develops the characteristic propensities of the individual to a striking degree. Air is forced in the great Sierra tunnel through wooden boxes, and the dis tance, leakage and friction being great, the supply was inadequate, and hence the accumulation of this nitrous gas at the header, the inhalation of which had the characteristic effect upon those working there as soon as one of them got an overdose. A muscular miner was brought out fighting, and it took four men to hold him until he returned to consciousness in the open air. A mail carrier went in and got a dose, and, when brought out, seized a couple of bars of iron, lashed them to his feet with wire, leaped over the dump and went sailing down the mountain over the snow."

TIN FROM NORTH CAROLINA.—A valuable vein of cassiterite has been found at King's Mountain, a small town in Shelby county, N. C. The vein discovered is between four and five feet in thickness, and has been struck in two places. The ore yields 869.2 pounds of tin per ton of ore. The finest ore in the English tin mines, at Cornwall, yields less than half this per cent of tin to the ton, and great expectations are therefore aroused concerning this new vein. Specimens of the ore, marked " unknown," were on exhibition at the Boston Exposition last summer, but it is only lately that the place of the vein has been made public.

Tin occurs sparingly at many other places in the United States, but has never been worked with profit.

SWEDISH MINERALS.— *Mangan-brucite.*—L. J. Igelström[1] describes some small grains of a honey-yellow or brownish-red color which occur in the hausmannite ore at the Jacobsberg mine in Wermland, Sweden. They are devoid of cleavage and are often colorless within, while deeply colored on the outside. Water is set free on the application of heat.

Analysis gave:

MgO	MnO	H_2O		
57.81	14.16	28.00	=	99.97

The formula $(Mg, Mn)[HO]_2$ is given, and the name *Mangan-brucite* proposed. Apparently, however, it is a mere alteration product.

Talc-triplite.—The same author finds in the lazulite of Horrsjöberg certain small yellow or yellowish-red translucent amorphous grains which, although intimately mixed with other minerals, he

[1] Oefvers. af Kgl. Vet. Akad. Förhandl., 1882, pp. 83–91.

regards as a new species. Before the blowpipe it melts to a black, metallic glass. Soluble in acids. Composition:

PO_5	FeO	MnO	CaO	MgO
32.82	16.12	14.86	14.91	17.42

Berzeliite.—Many rare minerals accompany the hausmannite of Sweden. Native lead, native copper, monimolite, atopite, ganomalite, chondroarsenite, hyalophane, ekdemite, hedyphane, braunite, manganophyllite, tephroite, manganosite, pyrochroite, manganbrucite, barylite, rhodonite are among the species found. Some of the above are very questionable species. Recently Igelström[1] has observed the rare mineral berzeliite in the hausmannite of Nordmark. It occurs both as a vein of a yellow massive material, and disseminated in grains through veins of calcite.

Analysis of the pure yellow material gave:

As_2O_5	CaO	MgO (with some MnO)	Pb and Cl
57.80	25.25	16.95	traces

The formula given by Dana (Mineralogy, p.544) is adopted.

Another variety of berzeliite, found many years ago at Longban has the formula of an orthoarseniate and is singly refracting, while that now described is doubly refracting. The physical characters of the two minerals are identical.

M. E. Bertrand[2] has made an optical examination of the two varieties of berzeliite, and finds that while the optical characters of the Longban variety are vague, differing in different parts of the mineral, those of the Nordmark variety are well marked and constant. The acute bissectrix is positive and the negative obtuse bissectrix is perpendicular to certain plane faces. It probably belongs, therefore, to the orthorhombic system.

Ganomalite.—M. Sjögren[3] has examined the silicate of lead and lime, to which Nordenskiöld has given the name ganomalite. He has found that the crystals are tetragonal, and show strong double refraction with a positive axis. As the cross traversing the rings is sometimes dislodged, more or less, he thinks it possible that the mineral may be biaxial with a very small optic-axial angle. Two analyses are given, the first of the variety from Longban, the second of that from Jacobsberg:

SiO^2	PbO	CaO	MnO	Gangue
20.40	69.42	9.89		0.29
18.33	68.80	9.34	2.29	1.24

Tephroite.—Very small crystals of tephroite have recently been found at Longban. A crystallographic investigation has shown that all the forms are those known in chrysolite, and that, as

[1] Bull. Soc. Min. de France, 1884, p. 27.

[2] *Loc. cit.*, p. 31.

[3] Geol. Fören. d. Stockholm, 1883.

Descloiseaux announced in his " Manuel de Mineralogie," tephroite and chrysolite are isomorphous.

Pyrosmalite. — Alex. Gorgen[1] communicates an analysis of pyrosmalite from Dannemora which is of considerable interest in that it shows a close analogy in composition with a silicate of manganese from Adervielle, Hautes Pyrenees, described by Bertrand under the name of Friedelite.

The oxygen ratios of the two minerals are as follows:

	SiO_2	MnO FeO CaO MgO	Cl Fe	H_2O
Pyrosmalite	18.24	11.56	0.84	7.60
Friedelite	18.37	11.42	0.80	8.53

Both minerals are remarkable for the energy with which they retain their chlorine and water. Both are hydrated chlorosilicates, and present chemically the same analogy as Bertrand has shown to exist between their crystalline form and their optical properties.

HAYDENITE.—H. N. Morse and W. S. Bayley[2] have reëxamined the variety of chabazite known as haydenite, found in the gneiss quarries near Baltimore. Cleaveland named the species in 1822, but its independence as a separate species was doubted until Levy, in 1839, showed it to be, as he supposed, monoclinic. But Dana afterwards showed Levy to be in error, demonstrating that the mineral was rhombohedral, occurring in scalenohedrons. He held that haydenite and chabazite were identical, although the analyses of the two minerals, yet made, differed. The analysis of Silliman and Delesse differed from one another and from chabazite.

The composition, as now ascertained, is (mean of two analyses):

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	BaO	K_2O	H_2O	
49.24	18.07	0.84	5.16	0.86	1.47	3.00	21.31	= 99.95

By regarding the iron as in the ferrous condition and, like magnesium and barium, replacing calcium, the analysis closely agrees with the recorded analysis of chabazite and with Rammelsberg's formula for that mineral. Haydenite is thus undoubtedly in all respects identical with chabazite.

BOTANY.[3]

AN OBSERVATION OF THE FERTILIZATION OF THE GERM CELL OF EQUISETUM ARVENSE.—The spores were started on the 30th of April. For some reason, for a time growth did not seem healthy, and they were neglected until the last of June, when I found that they had developed large prothallia, both male and female, the latter

[1] Bull. Soc. Min. de France, 1884, p. 58.

[2] *Amer. Chem. Journal*, March, 1884.

[3] Edited by PROF. C. E. BESSEY, Ames, Iowa.

much larger, and with longer and more forking branches. Young plants were first noticed June 30th, exactly two months from the time of sowing the spores.

On examining the prothallia, numbers of fresh archegonia were found at the base of the branchse, the germ cell being imbedded in the tissue of the prothallium.

On the third of July, I was fortunate enough to witness the entrance of the antherozoids into the archegonium.

Finding an archegonium that from its appearance was evidently on the point of opening, a portion of a male-prothallium, containing a ripe antheridium was placed upon the same slide.

For some time before opening, the four upper cells of the archegonium became much distended with water (Fig. 1) so as to present a somewhat bulbous appearance. These four cells gradually separate until finally they diverge widely. This open-

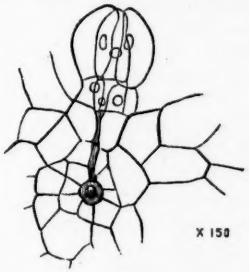

FIG. 1.

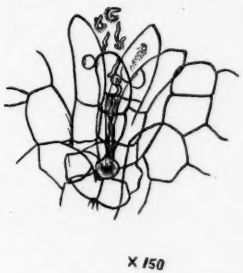

FIG. 2.

ing is accompanied by the discharge of a considerable quantity of transparent mucilage that collects in drops near the opening.

Within a few moments after the archegonium opened, an antherozoid made its way to the opening, and penetrated a short distance, but for some reason did not remain. Very soon, however, a large number collected around the mouth of the archegonium, soon one penetrated far down, followed by several others. The entrance was effected by a peculiar sinuous or spiral movement, but on account of the large size of the antherozoids, but one could pass down at a time, the diameter of the neck of the archegonium being small (Fig. 2).

The germ-cell, being buried in the tissue of the prothallium, prevented my seeing clearly the union of the antherozoids with it.—*D. H. Campbell, 91 Alfred street, Detroit, Mich.*

SISYRINCHIUM BERMUDIANA.—The following paper appeared in the April number of the London *Journal of Botany*, and is of such interest to botanists in this country that we reprint it entire:

"On first seeing the specimens of Sisyrinchium collected in the Bermudas, by Sir J. H. Lefroy and Mr. Mosely, I suspected that they were specifically different from the plant commonly

known as *Sisyrinchium bermudiana*, and after comparing them with numerous specimens of the plant so called from eastern North America, I was convinced that such was the case. Referring to the literature of the subject, I found this view supported by all the early writers who had actually seen the Bermudan plant. The history of the two species concerned is soon told. Towards the end of the seventeenth century Plukenet figured and briefly described what he termed the Bermudan and the Virginian Sisyrynchii, the types of which are still preserved in the Sloane Herbarium at the British Museum. Dillenius, who had opportunities of seeing living plants at Eltham, followed Plukenet in distinguishing these two species, and published better figures and more complete descriptions of them in the 'Hortus Elthamensis.' Linnaeus, who we assume did not see the Bermudan plant, as there is no specimen in his herbarium, united the two, as varieties of one, under the name of *S. bermudiana*. Miller, who seems to have been the most accomplished English botanist of his day, was the first to restore the two forms to specific rank. This was in 1771. In 1789 Curtis figured the true Bermudan plant and insisted upon its specific rank, remarking that he had living plants before him of both the species figured by Dillenius. Unfortunately he gave it a new specific name, for which he afterwards expressed his regret. The first DeCandolle wrote the text to the excellent figure of the Bermudan plant, which was published in Redouté's 'Liliacées,' at the beginning of the present century, and he particularly points out its distinctive characters. I have not taken the trouble to turn up every book in which the two species are likely to be mentioned, and I have not ascertained who was the first botanist to reunite them; but the North American botanists seem to be agreed that there is only one species of Sisyrinchium in the Eastern States, and this they designate *S. bermudiana*. The error probably arose in consequence of the Bermudan plant disappearing from European gardens, though the name was retained. *S. bermudiana* requires the shelter of a greenhouse in this country, not merely to protect it from frost, but also to enable it to attain its full development, while *S. angustifolium*, the other species, is perfectly hardy and grows like grass. Curtis, having been deceived by its behavior during a very mild winter, at first stated that the Bermudan plant was hardy, an assertion that he recalled in the letter-press accompanying the figure cited below of his *S. gramineum*."

The synonymy of the Bermudan plant follows:—

SISYRINCHIUM BERMUDIANA Linn. Sp. Pl., ed. 1. p. 954 (quoad β tantum); Miller, Dict., ed. 6; Lamarck Encycl. Method. Bot. i., p. 408; Redouté, Lil. t. 149.

Sisyrinchium *bermudense* floribus parvis, ex cæruleo & aureo mixtis; Iris Phalangoides quorundam; Plukenet, Amagestum, p. 348, et Phytogr., t. 61, fig. 2.

Bermudiana Iridis folio, fibrosâ radice, Tournefort, Inst. Rei Herb., p. 388, t. 108; Dillenius, Hort. Elth., p, 48, t. 41, fig. 48.

Sisyrinchium iridioides Curtis, Bot. Mag., t. 94.

Sisyrinchium bermudianum, var. 1, Baker in Journ. Linn. Soc. Lond., xvi., p. 117.

Endemic in the Bermudas.

Besides the Bermudan specimens alluded to above, there are cultivated specimens at Kew from the herbarium of Bishop Goodenough, presented by the corporation of Carlisle.

Sisyrinchium bermudiana differs from *S. angustifolium* in being much larger in all its parts, and strikingly so in its broad leaves, which are equitant at the base; hence Curtis's name *iridioides*. It grows eighteen to twenty-four inches high, and is stout in proportion. The flowers are large, and the broad segments of the perianth are obovate-mucronate; but I have not been able to compare the flowers, as there are none of the Bermudan species in a satisfactory state. However, a comparison of the figures cited should be sufficient to convince anyone of their specific diversity.

With regard to the forms of Sisyrinchium from eastern North America, if they are all to be regarded as belonging to one species, and we have the authority of the leading botanists in the States for considering them as such, Miller's name, being the earliest, is the one to adopt.

SISYRINCHIUM ANGUSTIFOLIUM Miller, Dict., ed. 6 (1771).

Sisyrinchium anceps Cavanilles, Dissert. vi, p. 345 t. 190, fig. 2 (1788).

Sisyrinchium gramineum Curtis, Bot. Mag., t. 464 (1799).

Sisyrinchium mucronatum Michaux, Fl. Bor.-Am. ii, p. 33 (1803).

Sisyrinchium bermudiana Linn., Sp. Pl., ed. i, p. 954 excl, *β. bermudense.*

Sisyrinchium bermudiana, A. Gray Man. Bot. Northern U. S., ed. 5, p. 517; Chapman, Fl. Southern U. S., p. 474; Baker in Jour. Linn. Soc. Lond., xvi, p. 117, excl. var. 1.

Sisyrinchium cæruleum parvum gladiato caule *Virginianum*: Plukenet, Almagestum, p. 348, et Phytogr., t. 61, fig. 1.

Bermudiana graminea, flore minore cæruleo: Dillenius, Hort. Elth., p. 49, t. 41, fig. 49,

Common in the Eastern States of North America, from Massachusetts to Florida, and naturalized in the Mauritius, New Zealand, and Australia. It also occurs in Ireland, where it is reported to be spreading; and as it so readily colonizes, it has been considered as an introduced plant, though, on the other hand, the North American *Eriocaulon septangulare* is generally admitted to be indigenous in Ireland. Since the above has been in type, Dr. Asa Gray has directed my attention to the fact that Mr. Sereno Watson pointed out, as long ago as 1877 (Proc. Am. Acad. Sc., xii, p. 277), that the Bermudan Sisyrinchium was a distinct species; but as he has neither elaborated the synonymy of the species, nor explained that the Linnean *S. bermudiana* was a composite one, he has only so far anticipated me that he recognized the Bermudan plant as different from the North American.—*W. B. Hemsley.*

BAILEY'S CATALOGUE OF N. A. CARICES.—This compilation is an attempt at a complete catalogue of the North American species of Carex. It includes two hundred and ninety-three species and eighty-four varieties. It contains the latest authentic nomenclature, besides a number of reductions by the author as a result of his personal studies in the Harvard University Herbarium. For convenience of reference, the arrangement is alphabetical, and in every case the general distribution is briefly given.

In comparing it with the latest edition of Gray's Manual, the more important changes which we note are the following:

C. stellulata (No. 36 Manual)	=	*C. echinata* Murr.
C. fœnea (No. 43 Manual)	=	*C. straminea* Schk., var *chlorostachys.*
C. limula (No. 47a Manual)	=	*C. vulgaris* Fries., var. *hyperborea.*
C. stricta (No. 51 Manual)	=	*C. angustata* Boott.
C. gynandra (No. 56 Manual)	=	*C. crinita* Lam., var. *gynandra.*
C. lanuginosa (No. 117 Manual)	=	*C. filiformis* L. var. *latifolia.*
C. paludosa (No. 123 Manual)	=	*C. acutiformis* Ehrh.
C. comosa (No. 126 Manual)	=	*C. pseudo-cyperus* L., var. *comosa.*
C. lupuliformis (No. 133 Manual)	=	*C. lupulina* Muhl., var. *polystachya.*
C. olneyi (No. 145 Manual)	=	*C. bullata* Schk.
C. rotundata (No. 149 Manual)	=	*C. miliaris* Mx.
C. pulla (No. 150 Manual)	=	*C. saxatilis* L.

C. pauciflora of the Manual (No. 4) is omitted from this catalogue.

Exchanges (and notes) in Carex, especially Western species, are solicited by the author. Copies of the catalogue may be obtained for five cents each, or in exchange for desiderata by addressing L. H. Bailey Jr., Botanic Gardens, Cambridge, Mass.

GRANT ALLEN'S COLORS OF FLOWERS.—The house of Macmillan & Co. has brought out in neat form a suggestive little book by Grant Allen, bearing the title of "The Colors of Flowers as illustrated in the British Flora." The book is an expansion of an article originally published in the *Cornhill Magazine*, and so is adapted to the wants andcapacities of the general reader. The general style of the book may be judged from the following paragraph from the introductory chapter:

"The flowers that most people observe and recognize as such, are the few highly developed forms which possess large expanded colored surfaces to allure the eyes of their insect fertilizers. It is with flowers in this more popular and ordinary sense that we shall have to deal mainly in the present little treatise; and our object must be to determine, not why they are all as a group brightly colored, but why this, that, or the other particular blossom should possess this, that, or the other particular hue. Why is the buttercup yellow, while the stitchwort is white, the dog-rose pink, and the harebell blue? Why is the purple fox-glove dappled inside with lurid red spots? Why are the central florets of the daisy yellow, while the ray florets are pinky-white? Why does sky-blue

prevail among all the veronicas, while yellow predominates in the St. Johnsworts, and white in the umbellates? These are the sort of questions which we must endeavor briefly to answer by the light of modern evolutionary biology, from the point of view of the function which each color specially subserves in the economy of the particular plant which displays it."

We should like to quote more from this fascinating little book, but enough has been given to make every reader wish to possess and read the whole book for himself.

FLOWERS AND THEIR PEDIGREES.—Much like the foregoing in the mode of treatment is the somewhat larger book, "Flowers and their Pedigrees," by the same author, and brought out in this country by the New York house of Appleton & Co. The chapters take up successively the daisy's pedigree; the romance of a wayside weed; strawberries; cleavers; the origin of wheat; a mountain tulip; a family history [the order Rosaceæ]; the cuckoo-pint.

In the family history the author says: "The method of our inquiry must be a strictly genealogical one. For example, if we ask at the present day whence came our own eatable garden plums, competent botanists will tell us that they are a highly cultivated and carefully selected variety of the common sloe or blackthorn. It is true, the sloe is a small, sour, and almost uneatable fruit, the bush on which it grows is short and trunkless, and its branches are thickly covered with very sharp, stout thorns; whereas the cultivated plum is borne upon a shapely spreading tree, with no thorns, and a well marked trunk, while the fruit itself is much larger, sweeter and more brightly colored than the ancestral sloe. But these changes have easily been produced by long tillage and constant selection of the best fruiters through many ages of human agriculture. * * * * *

"Now, if we push our inquiry a step further back, we shall find that this which is true of cultivated plants in their descent from wild parent stocks, is true also of the parent stocks themselves in their descent from an earlier common ancestor. Each of them has been produced by the selective action of nature, which has favored certain individuals in the struggle for existence at the expense of others, and has thus finally resulted in the establishment of new species having peculiar points of advantage of their own, now wholly distinct from the original species whose descendants they are. Looked at in this manner, every family of plants or animals becomes a sort of puzzle for our ingenuity, as we can to some extent reconstruct the family genealogy by noting in what points the various members resemble one another, and in what points they differ among themselves. To discover the relationship of the various English members of the rose tribe to each other—their varying degrees of cousinship, or of remoter com-

munity of descent—is the object which we set before ourselves in the present paper."

The book may profitably be read by all classes of intelligent people, not excepting the scientific botanists, who at least may learn from it how to write science in simple English for non-technical readers.

NORTH AMERICAN FUNGI.—Mr. Ellis delivered the 12th and 13th centuries of his now well known North American Fungi to his subscribers about the middle of April. We have repeatedly commended the successive centuries as they have appeared, and need only say that there is no sign of a falling off in their value. A notable feature of these centuries is the collection of Slime Moulds (Myxomycetes) which will be welcomed by many students.

THE FLORA OF BUFFALO.—The Buffalo Society of Natural Sciences has done a good work in issuing a catalogue of the native and naturalized plants of the city and its vicinity, compiled by David F. Day. It enumerates and gives localities for upwards of 2739 species and varieties, all of which have been detected within a radius of fifty miles. These are distributed as follows: phanerogams 1217; vascular cryptogams 53; mosses 165; liverworts 24; lichens 204; fungi 869; algæ 207.

ENSILAGE MOULD.—Attention has been called, in England, to the various moulds found on Ensilage. In a late number of the *Gardeners' Chronicle*, Greenwood Pim describes a form which appears to have puzzled some of the British mycologists. It seems to us, from the rude drawings given, to bear considerable resemblance to the Herbarium Mould (*Eurotium herbariorum*), and indeed, it may be simply an abnormal form of that or an allied species. The great heat, in connection with the great moisture of such a mass of decaying vegetable matter, may have modified the growth, as will readily be understood by those who have attempted various cultures of moulds.

However this may be, a suggestion made by Mr. Pim is well worth the attention of our collectors. "It seems not unlikely," says he, "that vegetable matters preserved in silos may yield us some new and interesting forms of fungi, the conditions under which the fodder has been placed, being so entirely different from usual."

A PARASITIC CUP-FUNGUS.—The habit of life of the Cup-Fungi of the genus Peziza is such, that we scarcely think of them as assuming the rôle of parasites. However, if we may credit a recent note by W. G. Smith, in the *Gardeners' Chronicle*, the abundant growth of the mycelium of *Peziza postuma* on heavily manured land became injurious to potatoes. The mycel-

ium completely exhausted all the moisture from the living stems, and reduced them to tinder, afterwards forming black masses of compacted hyphæ within the old stems. The trouble is said to have occurred last autumn in many parts of Ireland.

RED CLOVER IN NEW ZEALAND.—We have all heard much said about red clover and humble-bees, and of the non-production of seed by the clover in New Zealand, where humble-bees are not found. It is interesting to read the testimony of Mr. J. B. Armstrong, of the Christ Church Botanic Garden, New Zealand. After an extended discussion of the subject, he says in conclusion, "I think that we may safely assume, that the following facts, in connection with the fertilization of red clover in New Zealand are proved: 1. That no clover does produce its seeds in this colony. 2. That some varieties are much more fertile than others. 3. That there is every reason to believe, that numerous individuals belonging to the species are self-fertile, and that they produce self-fertile progeny. 4. That all the varieties show a tendency to produce pale-colored flowers. 5. That the common hive-bee, and its variety, the so-called hybrid Ligurian bee, frequently gather honey from the blossoms of the red clover, thereby, no doubt, aiding cross-fertilization. There is also reason to believe that the red clover is becoming modified in its structure, so as to admit the visits of insects not known to visit it in England, and that such modification tends to render the plant self-fertilizing, but at the same time enables it to be improved in constitutional vigor by occasional inter-crossing."—*Gard. Chron., Nov. 17, 1883.*

BOTANICAL NOTES.—Dr. Vasey's report as botanist to the Department of Agriculture, as published in the report for 1883, is devoted to the grasses, of which twenty-five species are figured. It is one of the most valuable portions of the report.——A recent paper by Dr. J. T. Rothrock, in the *Am. Journal of Pharmacy* (Laboratory Contributions from the course preparatory to medicine in the University of Pennsylvania), indicates that in at least one medical school in this country there is an excellent botanical course.——The Houghton Farm Bulletin, No. 3 (series iii) just received, contains Professor Penhallow's record of orchard observations and experiments, which have a botanical as well as horticultural interest.——The catalogue of the North Carolina Exhibit at Boston [1883] contains under the head of botany and forestry a list of logs, discs and planks which were exhibited to illustrate the forest flora of the State. Among them we note especially a holly (*Ilex opaca*), 33 inches in diameter; service-berry (*Amelanchier canadensis*), 14½ inches in diameter; persimmon 24 inches in diameter, and a red mulberry (*Morus rubra*), 25 inches in diameter.——Botanists will find many rare books advertised, for sale at reasonable rates, in a catalogue of botanical works just issued by Dulau & Co., 37 Soho Square, W. London, Eng.

ENTOMOLOGY.

EATON'S MONOGRAPH OF THE MAY-FLIES, PART I.—This is a well-worked and finely-illustrated memoir, which will necessarily remain a classic. For the first time we have a thorough treatment of the generic and specific characters of this group, comprising all the known living species of the globe, the American species receiving a good share of attention, being mainly from the Hagen collection of the museum at Cambridge.

Beginning with an account of the structure of the adult insects, while we have no comparisons made with other groups of insects, nor any attempt at a general morphological treatment of the subject, the reader is supplied with a judicious and reliable account of the different parts of the body, particularly the wings, the venation being discussed at length. We prefer the term "vein" to nervures, as the "veins" *are* temporarily at least blood-vessels, and have nothing in common with nerves; as the term "nervure" would suggest.

The facts stated as to the habits and mode of oviposition are fresh, and will be doubtless novel to our readers.

The popular superstition, says Mr. Eaton, that May-flies are strictly ephemeral, is fallacious in most instances. "It is true that the adult insect cannot eat, owing to atrophy of its mouth-organs and to the condition of its alimentary canal; but, provided that the air be not too dry, the imagines of many genera can live without food several days. Tradition states that Curtis kept a female Cloëon alive three weeks; this is an exceptionally long period, for in general an individual in confinement becomes perceptibly shrunken within three days, and is dead by the fourth day, if not before. Apparently there is some correspondence between the length of time spent in the subimago stage and the duration of the life of the imago; when the former amounts to twelve or twenty-four hours and upwards, the latter lasts more than a day; but when the change into imago takes place within a few minutes of the insects quitting the nymph skin, its life is fugitive, passing away in the course of the evening or early morning. In some genera of short-lived Ephemeridæ the subimago skin is partially or altogether persistent in one or the other of the sexes; and such portions of it as may be shed are moulted while the insect is in full flight." The longer-lived flies issue from the nymph-skin in a rather more matured condition than the others. The change from nymph to subimago is effected while the insect is floating at the surface of the water, buoyed up by gas which has accumulated within the alimentary canal and between the new and the old integuments of the body. The moult having been transacted in the ordinary manner, the subimago, standing upon the water with the wings erect awaits a favorable moment for flying to shelter. Fluttering steadily upwards it mounts aloft, some-

times to a considerable elevation, presently making its way to trees, walls or herbage, &c., likely to afford it a suitable resting place. Then it assumes the posture characteristic of its genus during repose. It may stand either upon all of its feet, or upon only the two hinder pairs; and the fore legs extended in advance, off the ground, may in this last case be held either close together or else apart from each other. The caudal setæ, in most instances divergent, are sometimes placed alongside of one another horizontally, or slanting upward.

The mode of flight of these graceful creatures is then described; usually, especially in the males, consisting of an intermittent action of the wings, which "results in a dance-like motion almost vertically up and down,—a fluttering swift ascent. and then a passive, leisurely fall, many times repeated." Other habits and the occasional swarming of certain May-flies are referred to, and their reproductive habits.

The facts regarding oviposition, must, we think be new to our readers. "Some short-lived species discharge the contents of their ovaries completely *en masse*, and the pair of fusiform or subcylindrical egg-clusters laid upon the water rapidly disintegrate, so as to let the egg sink broadcast upon the river-bed. The less perishable species extrude their eggs gradually, part at a time, and deposit them in one or the other of the following manners:—either the mother alights upon the water at intervals to wash off the eggs that issued from the mouth of the oviducts during her flight; or else she creeps down into the water—enclosed in a film of air, with her wings collapsed so as to overlie the abdomen in the form of an acute narrowly linear bundle, and with her setæ closed together —to lay her eggs upon the underside of stones, disposing them in rounded patches, in a single layer evenly spread, and in mutual contiguity. This has been witnessed by me several times, and in the case of several species of Baëtis. The female on the completion of her labor usually floats up to the surface of the water, ineffectively swimming with her legs, and, on emerging, her wings all at once are suddenly unfolded and erected; she then either flies away, or (as often happens) if her setæ have chanced to become wet and cannot become extricated from the water, she is detained by them until she is drowned. In some instances, however, the female dies under water beside her eggs."

The eggs are indefinitely numerous, some subrotund, others elliptical.

"Professor L. Calori (1848) and Dr. E. Joly (1877) have recorded instances of larviparition observed by them in *Cloëon dipterum*. Although they supposed that the young were produced from impregnated eggs retained within the mother, perhaps for some weeks, it may be conjectured with equal, if not greater probability, that these were the produce of unfertilized ova advanced

to maturity within the nymph and hatched as soon as she became an imago."

The young are then described; and the term nymph, since the larval and pupal stages are so much alike, is applied to all the "subaqueous stages in the development of the young after it is hatched." They mostly feed upon either mud or minute aquatic vegetation, such as covers stones and the larger plants; but (judging by their mandibles and maxillæ) some must be predaceous. The nymph of Palingenia is said to remain such one year.

The character and peculiarities of the nymph are given in great detail; while the means of distinguishing the subimago from the adult are stated. After a history of the classification of the Ephemeridæ, the bulk of the memoir is devoted to the systematic description of the genera and species. The illustrations are noteworthy from the attention given to the venation of the wings and other details, which, of course, add vastly to the value and permanency of the work; twenty-four plates being filled with the sketches, which are drawn upon a large scale.

NOTES ON MOTHS.—We have long had a specimen of the very rare *Sphinx elsa* Strecker, from Salt Lake City, Utah, given us by Mr. J. L. Barfoot, curator of the Salt Lake museum. It was originally described by Strecker from Arizona, and is well figured in his "Lepidoptera, indigenous and exotic." Like other moths from the Great Basin this has a peculiarly faded and bleached appearance, probably resulting from the light soil and bright skies of Utah and adjoining territories.

Smerinthus imperator Strecker occurred in a collection of moths, from Reno, Nevada, presented to us in 1877 by Rev. C. H. Pope. It agrees well with Strecker's figure, and is undoubtedly the same as the Arizona form; but until we have a suite of specimens of the Eastern *S. modestus* and the Western var. *occidentalis* H. Edw., from the Pacific coast for comparison, it will be difficult to decide whether it is specifically distinct from *S. modestus* of the Atlantic coast.

The following faunal notes on Bombycidæ may prove of interest:

Stenopis argenteomaculatus Harris, was taken by us at twilight in Gilead, Maine, in July. The second outer triangular silvery spot is obsolete; but the specimen agrees with Harris' figure in the style of marking. *Stenopis argentata* Pack., has been taken twice in Providence, in 1883, in June. One example belonging to Mr. G. E. Gray lacks the second outer silvery spot.

From Mr. J. L. Barfoot, of Salt Lake City, we have received *Pyrrharctia isabella;* from Dr. Palmer, in Southern Utah, and from Mr. Siler, of Ranch, Utah, specimens of very white bleached *Pseudohazis hera,* showing the same climatic effects as wrought

upon *Sphynx elsa*, *Euleucophæus gloverii*, *Gloveria arizonensis*, etc. In *P. hera* the discal dots are linear. *Epicallia virginalis* var. *ochracea* has been sent us from Southern Utah.

In Colorado we collected several years ago *Arctia achaia* Grote, Idaho Springs, July 6th; and with it occurred *Leucarctia permaculata* Pack. *Lycomorpha palmerii* was not infrequent at Manitou, July 16th; it was originally described by us from Southern California. In South Park Colorado, occurred *Tolype velleda*.

The localities of the following Geometrids are new: *Dasyfidonia avuncularia* (Guen.) Reno, Nevada; and in the same collection *Marmopteryx marmorata;* from Colorado (Scudder) *Selidosema inturnaria;* the same, var. *californiaria*, from Beaver Mts., Utah (Palmer in Scudder's collection).—*A. S. Packard, Jr.*

The Bird-louse (*Dermaleichus pici-pubescentis*).—In November, 1883, I found this interesting mite, first described by Professor Packard as occuring on *Picus pubescens*, on a specimen of the hairy woodpecker (*P. villosus*). They were especially numerous on the barbules of the feathers at the upper part of the throat, although they were also found on the feathers situated on the under side of the wings.

Besides the forms described by Professor Packard (see "Guide to Study of Insects"), there was another form, which is probably the hexapodous stage of the female, which has not yet been described.—*Clarence M. Weed.*

Entomological Notes.—The transactions of the tenth volume of the American Entomological Society, parts 3 and 4, contain most excellent matter: such as Lord Walsingham's notes on Tineidæ of North America; Mr. John B. Smith's synopsis of the North American Heliothinæ; Dr. Horn's miscellaneous notes and short studies of North American Coleoptera.——Dr. Williston publishes in the eleventh volume of the transactions of this society, a paper on the North American Asildæ, with a description of a new genus of Syrphidæ, with two plates.——Bulletin No. 3, U. S. Department of Agriculture, division of Entomology, comprises reports of observations and experiments in the practical work of the division, made under the direction of the entomologist, Professor C. V. Riley. It contains notes on the army worm, and experiments with pyrethrum, by C. V. Riley; notes on forest tree insects, by A. S. Packard, Jr. (containing descriptions of the transformations of *Eupithecia luteata*, *Caripeta angustioraria* and *Cryptolechia schlagenella*); a report upon the cotton worm in South Texas in the spring and early summer of 1883, by E. H. Anderson; experimental tests of machinery designed for the destruction of the cotton worm, by W. S. Barnard. The most important paper, and one of the best monographic accounts of an interesting group of moths which has appeared in this country, is Dr. James A. Bailey's "Some of the North American Cossidæ, with facts

in the life-history of *Cossus centerensis* Lintner," containing excellent biological matter, and illustrated by two well-engraved plates. The publication of this Bulletin marks a new era in the work and development of the entomological division of the agricultural department, and we hope the publication will be well sustained.——*Psyche*, vol. III, Sept.-Oct., 1882 (issued late in 1883), contains a noteworthy paper by Dr. Geo. Dimmock, on some glands which open externally on insects. Vol. IV, Nos. 115-116 contains Mr. Lintner's "New sexual character in the pupæ of some lepidoptera;" a very just tribute to the memory of J. L. LeConte, by C. V. Riley; the gills of insect larvæ, by G. McCloskie; the screw-worm-fly (*Compsomyia macellaria*), by S. W. Williston.——The oldest Tracheates known are probably two fossil myriopods from the Lower Old Red Sandstone (Devonian) of Scotland, described by B. N. Peach in Proceedings Royal Physical Society of Edinburgh, 1881-82.

ZOÖLOGY.

Occurrence of Chlorophyll in Animals.—C. A. MacMunn bases his conclusions as to the identity of animal and vegetable chlorophyll on the fact that the wave-lengths of centers of the bands of the same solutions of animal and vegetable chlorophyll are the same, and that the wave-lengths of the centers of the bands are the same when the same reagent is added to the respective solutions. Without committing himself to accepting the views of Kraus or Sorby, he applies the term chlorophyll to that coloring matter, or mixture of coloring matters, which can be extracted out of green leaves, such as those of Primula, by means of alcohol, or alcohol and ether. The coloring matter, to which the writer has given the name "enterochlorophyll," and which can be extracted from the liver or other appendage of the enteron of invertebrates, was shown to be probably produced by, and in, the body of the animal, and not food chlorophyll. The absence of parasitic algæ in sections of the livers of certain mollusks which yield enterochlorophyll, shows that this pigment cannot be due to their presence. The writer further showed that Pocklington's observations, published in the *Pharmaceutical Journal* in 1872, on the presence of chlorophyll in the wing-cases of Cantharides beetles, would be verified, and he had succeeded not only in verifying the presence of the principal chlorophyll band in the ether, chloroform, and alcohol solutions of the wing-cases; but the changes produced in the spectra of these solutions on the addition of certain reagents showed the presence of a body indistinguishable from vegetable chlorophyll. Hence, Leydig's conclusion as to the presence of that coloring matter in insects was proved to be correct. However, in the case of green larvæ the occurrence of a band in the red when a strong light is concentrated on the integument may be merely due to the presence of food chlorophyll

in the intestine, for, on squeezing out the contents of the latter, the green color and the band both disappear. It was then shown that chlorophyll could hardly be of much use in respiration, as oxydizing and reducing agents do not affect it; that for protective purposes or in mimicry a body of less complex chemical composition might answer equally well, except that the eyes of some invertebrates may be more susceptible to rays of light of a certain wave-length than our own, especially as Sir John Lubbock has shown that ants perceive the ultra violet rays of the spectrum which are invisible to us. It may possibly be the persistence of a pigment which was once useful in a remote ancestor in some cases, perhaps at a time when the atmosphere contained much more carbon dioxide than at present. Or, again, it may be of use in absorbing the chemically active rays of the spectrum when occurring on the surface of an animal, especially as Zimiriazeff had shown that Langley's observations with the bolometer have proved that the point of maximum energy of the solar spectrum corresponds with the principal chlorophyll band between B and C. In the case of enterochlorophyll this coloring matter may be of use in furnishing material for the construction of other coloring matters, especially as this body and Læmochromogen exist side by side in the bile of some mollusks; and in the bile of the sheep and ox a body exists which fluoresces red and resembles chlorophyll closely, but possesses at the same time some properties that show that it is a hæmoglobin derivative, as proved by the writer. The conclusions which have been arrived at gave support to the view which Professor Lankester has maintained, namely, that chlorophyll may occur quite independently of the presence of parasitic algæ, as in Spongilla and Hydra, and that it is in some cases produced synthetically by and in the bodies of animals.—*Journal of the Royal Microscopical Society, December, 1883.*

Vital Manifestations of the Sponges.—Taking the sponges as an example of a group in which tissues, organs and physiological divisions of labor are almost entirely absent, B. Solger makes them the starting-point in his proposed study of vital manifestations and their increasing complication in the animal kingdom. He gives a summary of facts deduced from observations by various writers.

The functions of *the endodermal ciliated chambers and cells* appear to be respiration and the prehension of nutriment, recent researches seeming to deny them the—at any rate the exclusive—power of actual digestion. The mesoderm probably shares in the latter function; the claim of the ectoderm to this position is less indisputable. The occasional occurrence of lipostry and lipogastry does not affect this question much, but relates chiefly to the manner of disposing of the used-up water. The function of exhalation is transferred in lipostomy to other canals and

pores; that of digestion in lipogastry is taken up by the ciliated chambers, or possibly by the ectoderm and mesoderm. The discovery of digestive ferments (pepsin, trypsin) in the body of the sponge has its importance somewhat reduced by the uncertainty which prevails as to the exact distribution of these compounds in the living animal. A reserve of nutriment occurs at certain times in several widely distinct sponges, and in some cases starch has been demonstrated between the cells, but there appears reason to regard this as derived from algæ. Oily matters have been extracted by chemical processes from sundry sponges, and traces of fatty matter have been observed. Though so commonly found dissolved in fatty matters in vertebrata, coloring matters are found abundantly in the sponges, although fats are so scanty in these organisms. They occur in the endodermal ciliated cells (*Spongelia avara*, Calcisponges) or in the mesoderm (*Euspongia officinalis*, Chondrosa). Some forms (Calcarea), from being colorless, take a brown color when placed in spirit; others (Suberites, Hircinia, and Stelletta, spp.) lose their color if exposed to the light. *Aplysina aerophoba* offers a remarkable example of change of color consequent on death, viz., from a sulphur-yellow to Prussian blue. This is caused by changes in certain roundish, refractive, mesodermal cells, with bladder-like nucleus, and small surrounding granular space. The color is preserved unchanged in solution of salicylic acid. The substance which produces it is considered to be reserve nutriment. The same body (aplysinofulvin) appears to occur in Aplysilla sp. and Hircinia sp., but changes much less rapidly in Aplysilla than in Aplysina, perhaps because the reducing ferment which hinders its conversion is decomposed more slowly in the latter case. The *horny fibers* have been shown to be excreted from special mesodermal cells. No proofs have yet been given of the occurrence of a moulding of the sponge-skeleton by absorption, such as the plasticity of such forms as *Ascetta elathrus* would seem to suggest. In connection with the rearing of sponges, it is remarked that Cavolin's observation that, after having taken root, the pieces of sponge shed over the old parts a mucilaginous mass, in which the skeleton subsequently appeared, might be utilized as giving a hint where to look for the youngest parts, when these are sought after, and thus further the study of tissue-development.—*Journal of Royal Microscopical Society, December, 1883.*

Pedal Glands of Mollusca.—J. Carriére thinks that the openings in the feet of Gasteropods or Lamellibranchs are the orifices of various glands; water does not seem to be taken into the blood directly either by their pores or by the kidney; nor is a quantity of water necessary for the erection of the foot, for the blood alone can bring that about. The renal cleft is not used as the means for introducing water into the blood, but rather as a

passage by means of which the fluid which passes into the pericardium from the blood can make its way into the kidneys. There are no indications of a water-vascular system in either Gasteropods or Lamellibranchs. In pursuing his investigations the author found great assistance from the air-pump, the use of which he learned at the Naples station. The thickest and largest pieces of the feet, which would otherwise have required several day's treatment, were rendered easy of section after a few hours. —*Journal of the Royal Microscopical Society.*

Suckers of Cephalopods.—P. Girod describes the suckers of *Octopus vulgaris* and *Sepia officinalis*, which are at first to be distinguished from one another by their sessile condition in the former and their pedunculated character in the latter; in the Decapod there is, further, a horny ring developed, but there is not, as in the Octopod, any elastic cup or construction, the cavity of the sucker forming a single chamber.

In the Octopod the suckers act thus: The animal contracts the extrinsic infundibular muscles, the sphincter of the orifice, and the inferior muscular envelope, and the form of the sucker becomes perfectly plane. Then the infundibulum or upper portion of the sucker becomes conical, the acetabular chamber enlarges, and its orifice dilates slightly; a vacuum is thus formed, and any pulling on the sucker only tends to separate the orifice from the base of the sucker, and so to increase the vacuum. In the Decapod there is a piston-like arrangement which becomes withdrawn by the action of lateral muscles, while the horny ring becomes more firmly attached. As the author justly points out, his results will be more completely displayed when he gives an account of the minute structure of the parts which he here mentions.

Researches on the Isopoda.—L. Huet, among the important additions which he has made to our knowledge of these Crustacea, has been able to prove the existence of large salivary glands, and that not only in the terrestrial, but also in the groups that are essentially marine, such as the Idoteidæ and the Cymothoidæ. This discovery is of especial importance when we remember that, with but rare exceptions, these glands are only found in land forms. On the other hand, we must remember that in certain Decapod crustaceans, small, glandular masses, which have given some indications of being salivary in character, have been already observed. Indeed, the author thinks himself justified in extending to the whole group the results which he has found true for the Isopoda.

With regard to the processes of respiration, the author made a number of experiments which resulted in showing him that, though there is a very close resemblance in the characters of the organs by which they are effected, there are but few found that can, without danger, exchange a terrestrial for an aquatic mode

of life, or *vice versâ*. Of such we have an example in Ligia, but here, as in all, the air respired must be damp.

Especial attention may be given to the sympathetic nervous system, the arrangement of which is as yet only incompletely known. It is much more complex than that of the Decapoda, and the splanchnic system appears to be analogous to that of the recurrent intestinal nerves of Limulus, arising, as the nerves do, from the hindermost of the nerves of the body. On the other hand, there is a close resemblance between the minute structure of the nervous system of the Isopoda and the Decapoda.

Lereboullet has already pointed out that the silky secretion formed by the cutaneous glands of certain terrestial forms presents a character in which they approach the Arachnida; and M. Milne-Edwards has regarded the so-called white bodies of the opercular gills as rudiments of a tracheal system. By their external form, some Isopods, as, for example, Armadillo, approach such myriopods as Glomeris; and, taking them on the whole, the Isopoda present a certain number of intermediate characters, by which they may be justly brought into association with various other groups of arthropods, and which, at least, give them a very special position among the Crustacea.—*Journal of the Royal Microscopical Society, December, 1883.*

Commensalism between a Fish and a Medusa.—In a consignment from the Mauritius, G. Lunel found united *Caranx melampygus* and *Crambessa palmipes*. The fish stuck with the greater part of its body in the apertures which are formed by the four columns uniting the stomach with the nectocalyx, and traversed by the gastro-vascular canals. This union could not be explained by the hypothesis that the animal had sought out the other as its prey and means of nourishment; for the medusa belongs to a family which possesses no proper oral aperture, but only a series of microscopic pores, which can only take in very finely-divided nourishment, and the fish had merely taken up his quarters in a natural hollow of the medusa, which was only enlarged, but in no way injured, by the long residence of the fish.

It was ascertained that the fisherman had taken the two animals together in that position, and that several years ago there had been seen on the coast, in a depth of about six inches below the surface, a fish of the same kind in conjunction with an anemone, and going in and out of it. The anemone into which the fish had entered was living, for it could be seen moving.

Lunel arrives at the conclusion that there are certain kinds of fish, the fully grown individuals of which live at more or less considerable depths; whilst the young, either on account of an unknown peculiarity of their organization, or because they require a diet more congenial to their age, ascend with particular medusæ to the upper regions of the sea, to find there the countless small

pelagic animals on which they and their hosts are nourished. It is noticeable that the fish, in order to enter the medusa, must swim upon its side, therefore in a very abnormal position.—*Journ. Roy. Microscopical Society.*

SNAKES IN NEBRASKA.—Miss C. C. Hopley writes thus in the *London Field:* From Nebraska a writer says that the number of snakes killed during the late overflow (July) of the Nemaha river is beyond belief. It is estimated that more than 3000 were killed near Falls City that had been driven by the water to the higher ground. They were chiefly Eutæniæ and Tropidonotus, with a few rattlesnakes. The writer, who had long been a resident of the locality, and who knew the country well, was "amazed" at the number of reptiles, and where they could have previously hidden themselves, as the overflowed district did not average a mile in width, and he had thought it sparse in snakes. One curious and comfortable retreat was in the long hair of a horse's mane. The animal had been confined in a pasture in the flooded district, and when released, several snakes were found thus hidden, and apparently tolerated.

THE PELVISTERNUM OF EDENTATES.—M. P. Albrecht notes the presence, between the pubes of certain Edentates, of elements which he believes to be pelvisternal. In *Manis pentadactyla* two small bones, cartilaginously united to each other and to the pubes, separate the latter; in *Dasypus sexcinctus* and *Cholæpus didactylus* a single bone exists; in *Bradypus cuculliger* this single bone has attained a comparatively large size; in a *B. tridactylus* examined, the bony pelvisternum was soldered continuously with the pubes, with traces of the union on one side; while in many Edentates the pubes are united by a continuous bony bar, without a trace of the junction. M. Albrecht believes that these facts show the order of evolution of this part of the pelvis of the Edentata, and that the paired ossifications in question represent a *sternum* of the posterior extremities formed of a single sternebra. The evolution of this bone is parallel with that of the body of the hyoid in Mammalia, and though it appears to be placed between a pair of elements only, instead of mid-way between two pairs, as is the case with the hyoid body, this difference disappears upon examination of the state of things in the Batrachia and Lacertilia. These have an ischio-pubic symphysis, and the symphysial cartilage seems to be homologous with the pair of small bones found in the Edentates. This pelvic sternebra finds, in the anterior limb, its homodynamic representative in the paired element which unites the precoracoid with the coracoid, that is, in the epicoracoids. For these corresponding parts of the anterior and posterior sternums, M. Albrecht proposes the names of *omosternum* and *pelvisternum.*

In front of the cartilaginous pelvisternum of the salamander is a Y-shaped cartilage, which Albrecht homologizes with the epi-

pubic cartilage of Lacertilia and with the marsupial bones of the Mammalia, and believes to be homodynamic with the episternum (Wiedersheim) of the Anura and the pair of substernal bones found at the anterior extremity of the sternum of some mammals, and even in man. These elements are, therefore, styled by M. Albrecht *pre-omosternum* and *pre-pelvisternum* respectively. The element existing behind the pelvisternum in the Lacertilia is similarly styled *post-pelvisternum*, while the *xiphisternum* of the Anura is the *post-omosternum*. These parts are considered by M. Albrecht to be formed by the ventral parts of the limb bones, and thus are not homologous with any part of the *costosternum*, which is composed of copulæ that link together the ribs.

The pelvisternum of the Mammalia had been noticed by two or three authors prior to M. Albrecht's paper.

SCALES, FEATHERS AND HAIRS.—The idea current among naturalists generally, and largely taught to students, that scales, feathers and hairs are identical in nature, is combatted by Mr. J. E. Jeffries in a recent issue of the Proceedings of the Boston Society of Natural History. Mr. Jeffries considers the epiderm to be the primitive skin, if not the true one, as it is formed long before the corium, which is a late and very variable product of the mesoblast; and because all the organs of sense are formed from it. The epiderm may be regarded as primitively consisting of a smooth mucous layer, an epitrichial layer, and perhaps an intermediate layer of parenchymatous cells. In birds and mammals the outer layer is lost, and never renewed, while the middle layer becomes thickened and subject to various modifications, as drying, conversion into horn, etc., and enters into the structure of all the appendages. Scales are molted and renewed, scuta are not. The toe-pads of birds may be seen to pass over into scuta on the sides of the toes of many birds. Scuta bear feathers as epidermal appendages—scales never do, thus pointing to scuta, which have a mucous layer and outer horn coat with a mesodermal core, as simple folds of the skin, not as appendages.

The early stages of a feather and of a hair differ. The latter is formed *in a solid* ingrowth of the epiderm, the latter from the epiderm of a large papilla. A hair does not contain any of the mucous cells, while a considerable portion of a feather consists of them. The supposed homology between feathers and scales seems to fail before the facts that the mucous layer is absent in the latter, and that Studer has shown that the imagined scale-like nature of the remiges of penguins is a fallacy. Mr. Jeffries avows his belief in the distinct origin of the dermal appendages of the higher vertebrates, and asserts that the nakedness of the Amphibia is a strong argument against the identity of any of the avian appendages with those of reptiles or mammals.

DR. COUES' RENUMERATION OF THE SPINAL NERVES.—The suggestion contained in Dr. Coues' article in the last number of the NATURALIST promises to relieve the student of human anatomy of certain difficulties in connection with the spinal nerves and plexuses. More important considerations will, however, deter comparative anatomists from adopting the suggestion.

The renumeration goes upon the principle that a spinal nerve is a strictly "intervertebral" structure, and that it is indifferent whether we associate it with the vertebra in front or that behind it. Such is, however, not the case. Each spinal nerve belongs to a particular vertebral segment of the body, that through whose neural arch or behind whose neural arch it issues, and ought to be named after that segment. There are many of the lower mammalia, Monotremata, Bruta, Ungulata, in which the spinal nerves perforate the neural arches of the segment to which they belong instead of issuing behind them. Thus the first dorsal nerve of a horse perforates the neural arch of the first dorsal vertebra. If we adopt Dr. Coues' nomenclature, we should have to say that the second dorsal nerve perforates the neural arch of the first dorsal vertebra—as unhappy an expression as any caused by reckoning eight pairs of cervical nerves.

In this respect the older nomenclature was less objectionable, for there the first spinal nerve was described as "suboccipital;" the second as first cervical, the eighth as seventh cervical, the ninth as first dorsal, &c., to the vertebral segments bearing which names the nerves really belong.

It is unnecessary to dwell longer on the above line of argument, for it has been fully elucidated by Dr. Albrecht (Zoölogischer Anzeiger, vol. III, 450 and 472), who regards the suboccipital nerve as the sole remnant of a *proatlantic* vertebral segment, traces of the osseous elements of which he finds in front of the atlas in the alligator and hedgehog. Whether Albrecht's proatlas be accepted by anatomists, or whether it be more probable that the segment to which the suboccipital nerve belongs has been swallowed up in the occipital region of the skull, does not affect the basis of his contention that a spinal nerve belongs to that vertebral segment through or behind whose neural arch it issues.

Of interest in this connection is Sagemehl's discovery of three rudimentary occipital nerves (with corresponding osseous elements) between the vagus and the first spinal nerve in Amia (Morph. Jahrb. ix, 190). Sagemehl concludes that all Teleostei must have originally possessed occipital arches. If what Sagemehl describes as the first spinal nerve of Amia is really homologous with the nerve of the same name in Teleostei, it is singular that no traces of the occipital nerves have been found in the latter unless, indeed, we are to assume that they have disappeared in the vagus.—*R. Ramsay Wright, University College, Toronto.*

ZOOLOGICAL NOTES.—*Protozoans.*—Kunstler describes *Trichomonas vaginalis* as extremely protean in external form. Pseudopodia arise over the general surface, or are localized at the posterior end.——G. Klebs discusses (*Bot. Zeitung*, 1883), the relationship of the Flagellata to the Algæ and Infusoria. Some Flagellata in the older sense are referred to the lower chlorophyllaceous Algæ; such are, in addition to the Volvocinæ, the Chlamydomonads. The fresh-water forms of the Peridineæ are, with Leuckart, regarded as plants. The Euglenaceæ and Peranemeæ are separated from the Ciliata and placed among the Infusoria.

Crustaceans.—A remarkable shrimp (*Nematocarcinus gracilipes*) was dredged by the *Talisman* at a depth of 850 meters, which is analogous to certain blind cave phalangids in the enormous length and slenderness of the antennæ and legs. The eyes are large and well developed, though the stalks are short. In a new form (*Acanthephyra pellucida*) the feet are adorned with phosphorescent bands.

Mammals.—Miklucho Maclay finds that the average temperature of the body of *Echidna hystrix* is 78° F., or very little more than that of fish, and about 25° less than mammals generally.—— So far as known, congenital deafness is only known to exist besides man in the cat, and always in white ones, and most usually in females.

PHYSIOLOGY.[1]

THE PHYSIOLOGY OF THE CARBOHYDRATES.—In the London *Lancet* of Januury and February, 1884, Dr. Pavy records some interesting experiments which prove the presence in the stomach and intestines of animal ferments which have been hitherto unknown. Dr. Pavy's general object was to discover the history of carbohydrates in the animal system:

1. Solutions of grape sugar placed in contact with the mucous membrane of the stomach or intestine of a recently killed rabbit, become changed into a carbohydrate which has less power of reducing Fehling's solution than grape sugar. Boiling the mucous membrane destroys its power of acting on glucose. This power of the mucous membrane is due to a ferment which is contained within the glands of the stomach and intestine, but is not secreted by the superficial epithelium covering the walls. The action of the ferment was gradual and progressed better at the temperature of the body than at lower temperatures. The ferment was not destroyed by drying and can be preserved when the mucous membrane is brought into this condition. In ruminant animals the ferment is not found in the true or fourth stomach, which corresponds to the single stomach of other animals, but in the three anterior chambers of the quadruplex organ.

2. The stomach and intestine are shown also to yield a ferment

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

which has the power of converting cane sugar into a carbohydrate which reduces Fehling's solution, but does so less completely than grape sugar; this product, as well as that previously described, has about the same reducing power as maltose. The stomach in animals generally contains much less of the cane sugar ferment than the intestine. This ferment appears to be contained not in the glands of the mucous membrane, but in the superficial epithelium of that coat. (It may be remarked that the cane-sugar-converting power of the mucus secreted by the lining epithelium of the stomach has long been known.)

3. This conversion of cane sugar into a maltose-like body occurs under physiological conditions, for when cane sugar is injected into the stomach of a living animal, if the portal blood be examined twenty or thirty minutes afterward, it is found to contain no cane sugar, but a carbohydrate like that produced from it by the action of the ferment already described.

HUMAN PHYSIOLOGY, BY HENRY POWER, F. R. C. S.—This is an excellent little book of its kind, but the kind is very poor. The work contains statements of a great number of physiological facts condensed within a small space, and will therefore be welcomed by the student who is cramming for an examination. But the teacher-physiologist who satisfies himself with the bare mention of facts, allows his subject to lose its chief importance as a discipline to the reasoning powers, and is liable to eventually miss his aim altogether, for isolated facts are with difficulty remembered when not strongly bound together into chains of cause and effect.

THE FIBRIN-FERMENT.—It is a question of considerable interest as to whether those peculiar bodies known as animal ferments, such as *ptyalin*, *pepsin*, *trypsin*, etc., are proteid substances, or whether they are of simpler chemical composition. Messrs. Lea and Green have recently investigated the so-called fibrin-ferment which induces coagulation in drawn blood, and they find that while it seems impossible to obtain the ferment in a solution which is quite free from proteid reaction, still this can be so nearly accomplished that there is little doubt that the ferment is a non-proteid body. The fibrin-ferment is best prepared by diluting fresh blood with 10—15 times its volume of water, and after the mixture has stood twenty-four hours, washing the clot until it is colorless; the clot is then pressed, rinsed and extracted in the cold for two days in 8 p. c. sodic chloride. This extract produces rapid coagulation of diluted blood plasma, and it may be nearly completely freed from proteids if a large amount of strong alcohol be added; a watery extract made from the precipitate thus formed will have marked ferment action.—*Journal of Physiology, vol. iv., No. 6.*

PSYCHOLOGY.

THE PRACTICAL TYPES OF MIND.—Men may be divided into three classes with reference to the practical use they make of their intellectual powers, which use is generally an indication of the type of intellect which they possess. These types are the mercantile, the literary and the scientific.

The first is occupied in accumulating material possessions, which often involves the deprivation of other people of them. Their reasoning powers are much occupied in calculating values, and in scheming to get control of the sources of physical power. It is a necessary outcome of the struggle for existence and is best developed in those whose struggles are most recent. This is a good training school, but a bad state to be permanent.

The literary mind deals largely with the *manner* of things, while the other two minds deal with the *matter*. Its field is with the beauties and refinements of life, and by sugar-coating the severities, performs great service in our education. Symbols are its instruments, and these it is prone to mistake for things.

The scientific mind occupies itself with realities, and finds chief value in the truth. This it seeks for and sets forth at all hazards. It finds its pleasure in mental rather than material possessions and counts its wealth in ideas. It differs from the mercantile mind in this, that it gives away its commodity for the benefit of others, while the mercantile sells to the highest bidder.

Sometimes two or more types of mind are combined in the same person, which may be a fortunate conjunction.—*E. D. Cope.*

CURIOUS COMPANIONSHIP OF THE COYOTE AND BADGER.—I have occasionally heard "cow boys" and others in Wyoming Territory speak of the existence of intimate social relations between the coyote (*Canis latrans*) and the badger (*Taxidea americana*). They report that the former not only travels in company with the latter, but often feeds and protects him. Up to the summer of 1883, I regarded these statements as the fruit of fertile imaginations, and as having no basis in fact. Observation, however, has compelled me to believe that intimate relations at least occasionally exist between these animals. During the last season I had the good fortune to see the coyote in company with the badger on three different occasions, and once under peculiar circumstances. I was engaged in making geological observations about fifteen miles east of the Beaver river, in Wyoming Territory, in a region of Miocene Tertiary bad lands. Sitting on a lofty butte examining some fossils, I saw, several hundred feet below me, a coyote and badger walking together, and every few minutes stopping and playing. The coyote would go in front of the badger, lay its head on the latter's neck, lick it, jump into the air, and give other expressions of unmistakable joy. Its antics with the badger were very much like that of a young dog playing with

another pup, or when meeting its master. The badger seemed equally well pleased. This playing and fondling of each other was kept up for over half an hour, and until they disappeared around the end of a butte near by. Again, during the month of March, when camped near the intersection of the Bridger road with the overland trail, a still more curious example of this companionship occurred. At early dawn I observed a coyote close to a pile of specimens, about 200 yards from my tent. The following night I placed some meat on this pile and the coyote "went for it," about the same time in the morning. I repeated this experiment, as my object was to observe more closely its habits, and especially to ascertain how tame it might be made by decent treatment. To my surprise, on the fourth morning the coyote was accompanied by a badger. The following morning the coyote came alone, but on the morning after that the badger again came along. After that neither coyote nor badger made their appearance, but why they abandoned my hospitable quarters is a mystery to me. In these instances the coyote carried off the breakfast that I had provided, and I could not tell whether or not it was shared with the badger. It, however, became evident to me that these animals do not associate by accident; they must have some affinity for each other, or else they would not thus come together.

The coyote is naturally sociable. Often when I have encountered him amid the wilds of nature he stood and gazed after me wistfully, as if he meant to say, "I wish I could have your company." He soon learns to know that man is his enemy, and for his own preservation gives him a wide berth.

It is not at all improbable that future investigation may show this fellowship to be a case of symbiosis. It is hoped that this will call out others who have had more extended opportunities to observe the habits of these animals. One of the first from whom I learned of this intimacy between the coyote and badger was W. U. Hoftile, of Lander, Wyoming Territory.—*Samuel Aughey.*

ANTHROPOLOGY.[1]

THE ASTOR LIBRARY.—The thirty-fifth annual report of the Astor library, for 1883, affords some information upon the popularity of anthropological studies. In the department of science and art there were 76,573 volumes called for; of these, 105 were upon anthropology; 783 upon archæology; 119 upon ethnology; 666 upon mythology, and 1020 upon social science. In the common acceptation, however, social science means more than it does in the anthropological sense. The latter includes only those works in which the rigid methods of natural history are applied to society. The former includes every speculation on the natural ills that flesh is heir to. In the department of history and literature the number of volumes called for was 89,824. Of these, 184

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

were upon chronology; 4559 upon heraldry and genealogy; 214 upon the history of American Indians; 739 upon oriental literature; 863 upon manners and customs; 717 upon Orientalia; 4404 upon philology and linguistics. Doubtless many other volumes were drawn for anthropological research, for instance, those on war, biology, domestic economy, ethics, geography, history, travels, etc.

THE BRITISH ASSOCIATION ANTHROPOMETRIC COMMITTEE.—In 1875 the British Association appointed a committee on anthropometry, of which Dr. William Far was chairman until 1878. The reports of the committee are as follows: 1878, 5 p, Annual Rep. 182–6; 1879, 35 p., *ibid.* 175–209; 1880, 41 p., *ibid.* 120–159; 1881, 48 p., *ibid.* 225–272; 1882, 3 p., *ibid.* 278–280; 1883, final report, 54 p., separate. The points to which inquiries were addressed are: 1. Stature; 2. Weight; 3. Chest-girth; 4. Color of eyes; 5. Color of hair; 6. Breathing capacity; 7. Strength of arm; 8. Sight; 9. Span of arms; 10. Size and shape of head; 11. Lower limbs; 12. Measures of other parts of the body. These measures were applied to the different elements of the mixed population of Great Britain and compared with those of other parts of the world. The results are partly shown in the following table:

Race or Nationality.		*Authority.*	*Meters.*	*Ft. In.*
Polynesian	Samoa 1.853	La Perouse	1.762	5 9.33
	Tahiti & Pitcairn 1.782	Garnot, Beechey		
	Marquesas 1.763	Porter, Cook, &c.		
	New Zealand 1.755	Various		
	Polynesians 1.753	Wilkes, Novara		
	Sandwich 1.731	Lesson, Rollin		
English professional class		Anthrop. Com.	1.757	5 9.14
Patagonians	1.778	Musters	1.754	5 9.00
	1.730	D'Orbigny		
Angamis (Naga hills)		Woodthorp	1.754	5 9.00
Negroes (Congo)		Topinard	1.752	5 8.95
Scotch		Anthrop. Com.	1.746	5 8.71
Amakosa Kaffirs		Sir A. Smith	1.741	5 8.50
Iroquois Indians		Gould	1.735	5 8.28
Todas (Nilghiries)		Marshall	1.727	5 7.95
Negroes (Calabar)		Topinard	1.727	5 7.95
N. A. Indians		Baxter	1.726	5 7.93
Irish		Anthrop. Com.	1.725	5 7.90
U. S. Whites		Baxter	1.719	5 7.67
English		Anthrop. Com.	1.719	5 7.66
Norwegians	1.727	Beddoe	1.719	5 7.66
" immigrants U. S.	1.717	Baxter		
Zulus		Roberts	1.707	5 7.19
English laborers		Anthrop. Com.	1.705	5 7.08
Canadians, U. S., French immigrants		Baxter	1.703	5 7.01
Tajiks of Feyhana & Samarkand		Ujfalvy	1.705	5 7.10
Swedes, U. S., immigrants		Baxter, Beddoe	1.700	5 6.90
Chippeway Indians		Oliver	1.700	5 6.90
Kabyles		Topinard	1.699	5 6.85
Welsh		Anthrop. Com.	1.695	5 6.66
Danes, U. S., immigrants		Baxter	1.694	5 6.65
Dutch, " "		Baxter	1.693	5 6.62
American Negroes		Baxter	1.693	5 6.62

Race or Nationality.	*Authority.*	*Meters.*	*Ft. In.*
English, U. S., immigrants	Baxter	1.692	5 6.58
Hungarians	Baxter	1.692	5 6.58
English Jews	Anthrop. Com.	1.692	5 6.57
Germans, U. S., immigrants	Baxter	1.691	5 6.54
Swiss of Geneva	Dunant	1.688	5 6.43
Swiss, U. S., immigrants	Baxter	1.687	5 6.38
Russians, " "	Baxter	1.687	5 6.38
Belgians	Quetelet	1.687	5 6.38
French, U. S., immigrants	Baxter	1.683	5 6.23
Poles " "	Baxter	1.682	5 6.20
French upper classes	De Quatrefages	1.681	5 6.14
Germans	Novara	1.680	5 6.10
Mexicans	Baxter	1.680	5 6.10
Berbers of Algeria	Topinard	1.680	5 6.10
Arabs	Various	1.679	5 6.08
Usbeks of Ferghana & Samarkand	Ujfalvy	1.679	5 6.08
Javanese	Novara	1.679	5 6.08
Persians	Shulz	1.678	5 6.04
Italians, U. S., immigrants	Baxter	1 677	5 6.00
South American "	Baxter	1.675	5 5.90
Australians (aborig.)	Various	1.669	5 5.68
Austrian Sclaves	Novara	1.669	5 5.68
Galchas, Iranian mountaineers	Ujfalvy	1.668	5 5.66
Spaniards, U. S., immigrants	Baxter	1.668	5 5.66
Berbers of Algeria	Topinard	1.666	5 5.62
Portuguese, U. S., immigrants	Baxter	1.663	5 5.43
Ainos	Rosky	1.660	5 5.33
Austrian Germans	Novara	1.658	5 5.27
French working classes	De Quatrefages	1.657	5 5.24
Eskimo, N. A.	Various	1.654	5 5.10
Hungarian (military statistics)	Scheiber & Beddoe	1.652	5 5.04
Caucasians	Shortt	1.650	5 4.93
New Guinea	Various	1.646	5 4.78
Hindoos	Shortt	1.645	5 4.76
Bavarians	Novara	1.643	5 4.68
Ruthenians	Majer & Kopernicki	1.640	5 4.54
Dravidians	Shortt	1.639	5 4.50
Cingalese	Davy	1.638	5 4.48
Austrian Roumanians	Novara	1.631	5 4.37
Chinese	Novara	1.630	5 4.17
Italian conscripts (1.620)	An. di Statist. 1879	1.626	5 4.00
Fuegians	Novara	1.625	5 3.98
Polish Jews	Mayer & Kopernicki	1.623	5 3.88
Poles	" "	1.622	5 3.87
Finns (Beddoe, 5 ft. 5.81)	Novara	1.617	5 3 60
Papuans	Various	1.606	5 3.20
Japanese	Mrs. Ayrton	1.604	5 3.11
Aymaras, Peru	Forbes	1.601	5 3.00
Peruvians	D'Orbigny	1.600	5 3.00
Cochin Chinese	Finlayson	1.593	5 2.70
Malays	Raffles, Crawfurd, &c.	1.583	5 2.34
Veddas of Ceylon	Bailey	1.536	5 0.42
Lapps	Horch	1.500	4 11.2
Andamanese	Man	1.492	4 10.7
Aëtas	De Quatrefages	1.482	4 10.3
Semangs	De Quatrefages	1.448	4 9.0
Mincopese	De Quatrefages	1.436	4 8.53
Bosjesman	Various	1.341	4 4.78
Differences between the tallest and the shortest		.421	1 4.55
Average stature of man		1.658	5 5.25

ANTHROPOLOGY AT THE NATIONAL CAPITAL.—The city of Washington is becoming such an important center of anthropological material and research, that students in other places are likely to become confused in seeking for any special information. To prevent embarrassment it is well to bear in mind the following facts:

1. In the Smithsonian building proper is the Department of Antiquities, in charge of Dr. Charles Rau. Here are deposited all relics recovered from mounds, graves, ancient structures, caves, shell-heaps, etc., situated in our own country; all relics of antiquity from abroad; and the artefacts of stone, bone, shell, ivory, etc., found in the United States and known to be the handiwork of the aborigines. Many other typical objects of culture are also on exhibition in Anthropological hall. Archæologists visiting the capital will naturally make this collection the central point of their investigations. A more minute description of Dr. Rau's work will be given in a subsequent number of the NATURALIST.

2. Under its present organization the National Museum has a Department of Arts and Industries, of which Professor G. Brown Goode is curator. One section of this department embraces savage and barbarous industries, and to this we now direct especial attention. No professional ethnologist is in charge, but Mr. J. K. Goodrich is engaged in arranging the material, and Ensign Albert P. Niblack. U.S.N., has been detailed to study here. This branch of the museum has, for a nucleus, the Wilkes collection, and it includes all the specimens formerly combined with Dr. Rau's department, but not representative of the stone age. From all parts of the world objects have come to enrich this ethnologic treasury, and it would be impossible to mention even the names of the contributors. The Centennial Exhibition at Philadelphia was the means of greatly enhancing the store. During the past year most valuable additions have been made to this part of the National Museum.

Mr. C. L. McKay, signal officer, recently drowned in the Alaskan seas, sent over a hundred specimens of the hunting and fishing apparatus used by the natives of Bristol bay.

Mr. J. J. McLain, signal officer, gathered a typical set of textile work and a number of pipes from the vicinity of Sitka.

Mr. W. J. Fisher, in the same service, donated over 150 specimens of dance ornaments, weapons and household utensils from the same region.

Mr. Stejneger, signal officer, made fine collections on Bering isles, Commander group.

The National Museum has succeeded in effecting an exchange with the Leipzig museum, founded originally in Dresden by Dr. Gustav Klemm, by which a large number of tools and weapons from the west coast of Africa have come into possession.

Lieutenant Ray gathered at Point Barrow an illustrative series of Eskimo objects.

Collections of musical instruments have been contributed from Tiflis, and by Mr. J. H. Foot, of New York.

The Bureau of Ethnology has just turned over to the museum its entire store of pottery, ceremonial apparatus, foods, textile fabrics, arms and implements from the Zunis and the Moquis. This gift includes many thousands of specimens.

The most interesting addition made to the museum by any of its special agents last year, was that secured by Mr. J. G. Swan, of Washington Territory. It consists of miscellaneous objects gathered along the north-west coast from Sitka to Puget sound, together with exhaustive types from the Haidahs and the Makahs. From the former come the beautiful objects in carved slate. Besides the miniature totem posts, with their allegorical figures and a great variety of dishes and pipes, there are square covered boxes, richly ornamented, that would hold five or six gallons. The Makah material, gathered with special reference to the London fishery exhibition, includes every kind of object that enters into this industry among this tribe.

3. The Bureau of Ethnology is under the direction of Major J. W. Powell. Its function is to study the anthropology of the North American aborigines, living and extinct. The work of the several parts of this bureau will be more fully described in the future.

All of the institutions just described are more or less officially connected with the Smithsonian Institution, under the direction of Professor Spencer F. Baird. The first named has for its medium of publication the Smithsonian Contributions to Knowledge, Miscellaneous Collections, and Annual Report; the second makes known its operations through the Proceedings of the National Museum; and the Bureau of Ethnology publishes its Annual Report, and Contributions to North American Ethnology.

4. The Army Medical Museum, under the official direction of Dr. Robert Murray, Surgeon-General, U. S. A., and in charge of Dr. John S. Billings, is devoted to anthropology in its more restricted sense. Here are deposited crania, skeletons, preparations of soft parts, microscopic sections, etc., relating to the human body. It is here also that the great Index-Catalogue is made up and Index Medicus is edited.

5. The Anthropological Society of Washington, numbering now one hundred and fifty members, holds its meetings at the Army Medical Museum, on the first and the third Tuesday in each month. The society has published two volumes of Transactions and is in a flourishing condition. Major J. W. Powell is president for 1884, and Colonel F. A. Seely, U. S. Patent Office, is secretary, to whom all communications should be addressed.

There are many departments of the Government where anthropological material is gathered and where excellent contributions

are made to this science. Indeed, there is not a single department of anthropology that is not well represented in Washington. The Patent Office, the Census Bureau, the Board of Health, the Department of Agriculture, the Signal Office, the Indian Office are only a few of these. Further reference to some of these institutions and their operations will be made in future numbers of the NATURALIST.

MICROSCOPY AND HISTOLOGY.[1]

METHODS OF INVESTIGATING ANIMAL CELLS.—Dr. Brass has devoted several years of close study to the structure and life of animal cells, and a detailed account of his methods appears in the first number of a new journal of microscopy.[2] The following are some of the more important of these methods:

1. *Protozoa.*—As most Protozoa move very rapidly when hungry, it is well to feed them before attempting to study them with the microscope. If well fed with powdered pieces of plants, &c., they usually remain quiet after a short time, and begin to assimilate the food-material which they have appropriated. In this condition of comparative quiet they can be easily examined with high powers. For this purpose they may be placed under a cover-glass with considerable water and a number of small green algæ to keep the water supplied with oxygen.

For higher powers Abbe's illuminating apparatus is extremely useful. In some cases it is desirable to have a completely one-sided illumination, and this is best effected by inserting beneath the illuminating apparatus a circular diaphragm-plate perforated with a slit 3^{mm} wide that runs parallel to the edge of the plate. It is best to have about 2^{mm} between the slit and the edge of the plate. Several diaphragm plates should be prepared in which the slit varies in extent from a half to a whole of a quadrant or more.

The following mixture, which is Meckel's fluid with the addition of a little acetic acid, is recommended above all other reagents as a preservative medium:

Chromic acid	1 part.
Platinum-chloride	1 "
Acetic acid	1 "
Water	400–1000 "

Unicellular animals die very slowly in this mixture, and suffer very much less alteration in structure than when killed in osmic acid or picro-sulphuric acid.

A special method is required for Protozoa filled with opaque food-material. In many cases the nucleus and the structure of the cell-body are completely obscured by foreign bodies. The method adopted in such cases is as follows:

(1) Placed in picro-sulphuric acid 3–4 minutes.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

[2] *Zeitschr für wiss. Mikroskopie*, I, No. 1, pp. 39–51, 1884.

(2) Transferred to boiling hot water for a short time.
(3) Placed in water and a little ammonia added; this causes the contracted object to swell up to its original size and form.
(4) Neutralize the ammonia with a little acetic acid, and then
(5) Color with borax-carmine or ammonia-carmine.
(6) Wash and examine in dilute glycerine.

The picro-sulphuric acid destroys the nutritive material; the ammonia dissolves any particles of fat that may be present; and thus the object becomes transparent so far as possible.

A concentrated solution of corrosive sublimate may also be used with success for killing Protozoa; but care must be taken to wash thoroughly.

Dr. Brass has obtained his best results without reagents or dyes.

2. *The nature of Chromatin.*—Dr. Brass has advanced an entirely new theory in regard to the colorable portion of the nucleus. Hitherto it has been very generally supposed that the chromatin (Flemming) plays an important part in cell division, but Dr. Brass maintains that it represents simply surplus food-material. This opinion is supported by the fact that well-fed cells contain chromatin in abundance, while cells deprived of food for a considerable time appear to lose the chromatin.

Pfitzer's Method of Coloring and Hardening at the same time.[1]—To a saturated aqueous solution of picric acid add a small quantity of an aqueous solution of nigrosin. This gives a deep olive-green mixture which kills very quickly and stains at the same time that it hardens. After a few hours' immersion the object may be transferred to water or alcohol for removing the acid and the nigrosin which remains in solution.

This method is very good for preparing small objects that have to be killed, hardened, stained &c., under the cover-glass.

Filtering Reagent Bottle.[2]—The usual forms of filters of paper and cotton are not as convenient as one could wish, and it was with a view to the production of a simple apparatus which would deliver, perfectly filtered, any quantity of a staining-fluid, or other reagent from a single drop to a dishful, that I devised, about two years ago, the bottle here described. A wide-mouth bottle of convenient size is fitted with a cork through which three glass-tubes are passed; one of which (Fig. 1, *a*) reaches nearly to the bottom of the bottle, while the other two tubes extend only just below the cork.

The long tube is curved above the cork, and at a point just beyond the curve there is attached to it a short piece of tubing (*b*) of twice the diameter of the first. The lower end of this larger tube (at *d*) is also fitted with a cork, through which passes a short piece of small tubing, which is slightly contracted at its distal end.

[1] Ber. Dtsch. Botan. Gessellsch., 1, No. 1, p. 44, 1883.
[2] Devised by C. E. Hanaman.

Over the cork and open end of this short delivery tube, a piece of fine muslin (*d*) is stretched, and the space (*b*) in the large tube is filled with a loosely packed plug of absorbent cotton, forming an effectual filter. The second tube ends above the cork in a "thistle-bulb" funnel (*e*), the opening in which is formed into a neck of sufficient length to enable one to cork it securely. Through this thistle-top tube the reagent may be readily poured from a dish or other vessel. The third tube (*g*) is bent over the side of the bottle and a piece of rubber tubing is attached, which may end either in a short glass mouth-piece or atomizer-bulb, as the student may elect. In case the bulb is used it will be found necessary to loosen the cork in the funnel-tube (*e*) when a sufficient quantity of the contents has been expelled, in order to release the pressure and stop the flow.

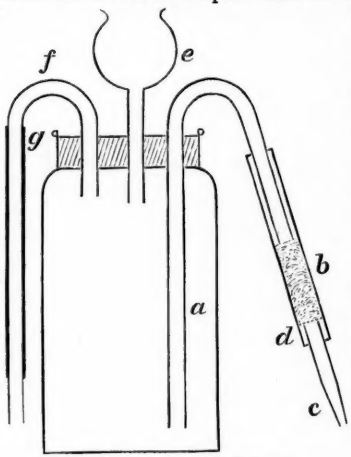

FIG. 1.—Filtering Wash-bottle.

This bottle differs from the one described at Montreal only in the use of the thistle-top tube and common bottle, in place of the more expensive three-neck or Wolfe's bottle. The thistle-top tubes may be purchased for about fifteen cents apiece, while the Wolfe's bottle would cost fifty cents or more.

Further, the thistle-funnel permits a solution to be readily poured into it from a dish, while the necks of the Wolfe's bottle are so small that the use of a funnel is necessary, except when the solution is poured from a spout or bottle-neck. Stains may thus be returned to the bottle and used over and over again, being perfectly filtered each time they pass through the plug of cotton. A gentle breath at the mouth-piece, or a slight compression of the bulb, expels a single drop, while by blowing steadily for a moment, or rapidly working the bulb, a dishful of the reagent is obtained.

When the plug of cotton becomes foul, which will not be for a long time, even with hematoxylin stain, it may be replaced by a fresh one by simply uncorking the lower end (*d*) of the large tube, pulling out the old plug with a pair of forceps and inserting a fresh one. The cotton should be but loosely packed to work easily. If the contracted end of the delivery tube becomes clogged through long disuse, it may be freed with a pin or fine wire, and the first dishful of the reagent returned to the bottle, when it will be found that the succeeding dishful will be perfectly filtered.—*From the Am. Mo. Mic. Jour. March, 1883.*

NOTES ON THE USE OF THE FREEZING MICROTOME.[1]—The tendency at the present time is to make all microscopic sections by the dry method after paraffin infiltration and imbedding; but no doubt there is a place, and an important one, for the freezing microtome in practical histology, and in this note I would like to call the attention of the readers of *Science Record* to what seem to me improvements in its use. Disliking greatly the disagreeable "muss" made by ice and salt, it occurred to me to take advantage of the device of plumbers to thaw out water and gas pipes, to use strong alcohol with the ice or snow instead of salt. By using snow or finely powered ice and ninety-five per cent alcohol, a temperature of twenty centigrades below zero is obtained within five minutes, and this temperature may be maintained with far less trouble than with ice and salt. The microtome used is the Rutherford pattern modified by placing the drain near the top instead of in the bottom. A rubber tube passing from this drain to a jar, preserves the overflow. It requires about 250 cc. of alcohol to freeze and keep frozen one tissue for cutting, but this is not lost, as little evaporation takes place and the dilution does no harm for many purposes, hence the method is not wasteful, while it is much more pleasant and expeditious than with salt.

Ordinarily tissues are infiltrated with thick gum before freezing, and then the sections are soaked in a relatively large amount of water to remove the gum. Evidently while soaking, staining and transferring the sections, especially if they be of such an organ as the lungs, there is every liability of their becoming folded or torn. This may be avoided by staining the tissue in the mass as for dry section cutting, and then soaking in water to remove any alcohol, and finally completely infiltrating the tissue in a thick solution of very clean gum arabic. When ready to make the sections the well of the microtome is filled with the thick gum and the tissue introduced at the proper time as usual. Before cutting the gum is cut away from the tissue, as in sharpening very bluntly a lead pencil, then as the sections are cut they are transferred directly to the slide. After several slides are filled, a drop of glycerine is added to each section and the cover-glass applied. This is practically mounting in Farrant's solution.

Instead of using gum arabic, Professor Sollas[2] recommends gelatine prepared as for glycerine jelly. This is used in every way as described for the thick gum, and the sections are placed upon the slide and covered with glycerine and the cover-glass applied. In this modification the sections are practically mounted in glycerine jelly. The cover-glass may be sealed in any approved way for either of the methods just described.—*S. H. Gage, Cornell University, March 1, 1884.*

[1] From *Science Record*, No. 6, April, 1884.

[2] Professor J. Sollas. An improvement in the method of using the freezing microtome. *Quarterly Journal of Microscopical Science*, Jan., 1884, p. 163.

SCIENTIFIC NEWS.

— In examining sponges Mr. H. J. Carter, according to the Journal of the Royal Microscopical Society, finds that the quickest way is to soak a microscopic fragment of it in distilled water for from twelve to twenty-four hours, then tear it to pieces on a slide, drain, dry, and mount with balsam as usual; but to be *certain* of the exact form of its spinules requires that they should be boiled out with nitric acid, which may also be easily and quickly effected by placing the microscopic fragment on the centre of a glass slide and covering it with a drop or two of nitric acid, then boiling this over a spirit lamp with low flame till it is nearly dry, after which the same process must be repeated twice or thrice; and, finally, before the last drop of nitric acid is entirely dried up, removing the slide to the table, when through gradually increased inclination and sufficient but careful edulcoration with distilled water, the residuum may be freed from all remaining acid, drained, dried, and mounted in balsam; or if desired, another microscopic fragment, prepared as first-mentioned, may be added to it previously, when the perfect form of the spicules respectively, together with their position *in situ*, may be seen at once in the same preparation.

— Mr. H. P. Aylward, according to the *Journal* of the Royal Microscopical Society, has designed a set of apparatus for pond-life hunting, the novel feature of which is that the holder for the bottle is made of steel wire, one end grasping the neck of the bottle, and the other end being a hollow spiral, in which the taper end of any sized walking stick may be inserted. The hook is similarly attached to a spiral. The dipping-bottle packs in a japanned cylindrical tin box, the upper half of which is composed of very fine copper gauze. When the bottle is emptied into this box, the organisms will be retained in the lower part, and the surplus water escape through the gauze. This operation may be repeated any number of times, and the contents afterwards returned to the bottle. For special gatherings, another japanned box is supplied, containing several large test-tubes. The size of the cylindrical box and its case containing the bottle is 5 in. × 2 in., that of the box with test-tubes, 5½ in. × 3½ in. × 1 in.

—The Entomological Society of Washington has organized with the following officers: President, Dr. C. V. Riley; first vice-president, Dr. J. G. Morris; second vice-president, Geo. Marx; recording secretary, E. A. Schwarz; corresponding secretary, L. O. Howard; Treasurer, Ben. P. Mann; executive committee, the officers and Dr. W. S. Barnard, P. R. Uhler and Dr. A. J. Shafhirt.

The first regular monthly meeting of the society was held April 3d, in the council chamber of the U. S. National Museum. The following papers were read: 1. Some new facts concerning the

late Dr. Townsend Glover, by C. V. Riley. 2. On insect collecting at Pt. Barrow, Alaska, by John Murdoch. 3. On the insect fauna of the District of Columbia, by E. A. Schwarz. 4. On the so-called "mistaken parasite," by L. O. Howard.

The active membership list of the society numbers over twenty names. Meetings are held on the first Thursday evening of each month.—*L. O. Howard, corresponding secretary.*

—The only American sea-side laboratory now open to students and investigators in general is that sustained by the Boston Society of Natural History at Annisquam, Mass. The session begins June 20th, and closes September 7th, 1884.

The work in the laboratory will be under the immediate care of Mr. J. S. Kingsley during June and July, and Mr. B. H. Van Fleck, assistant in the laboratory of the Boston Society of Natural History, during August.

Applications for entrance should be made to Professor A. Hyatt, custodian of the Society of Natural History, Boston, Mass.

—The final outburst of the Krakatoa volcano took place at 12 minutes to noon on August 27th of last year, and a great tidal depression was created in the Straits of Sunda. At 1.30 p. m. of the same day a wave was felt at Pointe de Galle, in Ceylon, 3000 kilometers distant, and at 2.15 p. m. one was felt at Mauritius, 5500 kilometers distant. Calculating from these observations, M. de la Croix, a French physicist, estimates the velocity of the molecular disturbance through the water of the ocean to be 2000 kilometers per hour, 550 meters per second higher than the recognized velocity of sound in air.—*The English Mechanic.*

—The total amount appropriated to the French Institute in the Budget for the year 1884, is 720,000 francs, of which the Academie Française receives only 98,000 francs, and the Academie des Sciences as much at 203,000 francs. Every member of each section of the Institute receives 1500 francs a year, the permanent secretary of each section, 6000 francs; the remainder is for special work, memoirs, prizes, etc.

—M. Girard has bequeathed to the French Association for the Advancement of Science, a capital sum of 100,000 francs, the interest of which is to be devoted every five years to the encouragement of researches into the antiquity of man, with especial reference to geological time.—*The Academy.*

—Professor Allen Thomson, of London, well known for his writings on embryology, recently died at the age of 75. His professorial life dates from 1839, when he was appointed to the chair of anatomy in Marischal College, Aberdeen. From 1848 to 1877 he was professor of anatomy in the University of Glasgow; but in the latter year, having been appointed president of the British Association (Plymouth Meeting), he retired from professorial life, and settled in London. Allen Thompson published only one "book," his "Outlines of Physiology" (1847), but he wrote many

papers, and contributed numerous articles to the cyclopædias. Thomson early saw the truth in the theory of evolution, and taught it when it was not fashionable.

— Dr. George Engelmann, born at Frankfurt on-the-Main, February 2d, 1809, died, in the midst of his scientific labors, at his home in St. Louis, on Monday, February 4th, 1884, in the seventy-fifth year of his age.

—The grand honorary Walker prize of $1000 has been awarded by the Boston Society of Natural History to Professor James Hall, of Albany, for his palæontological investigations.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

NATIONAL ACADEMY OF SCIENCES, April 15–18.—The number of members present was nearly forty, the session lasting four days. An interesting feature of the meeting was the announcement that Mrs. J. Lawrence Smith has presented, as a memorial of her husband, a member lately deceased, a fund of $8000 for the promotion of research on meteorites. Five new members were elected, viz., Edward S. Dana, C. B. Comstock, S. I. Smith, C. E. Dutton and W. K. Brooks.

The following papers were read:

The sufficiency of terrestrial rotation to deflect river courses. G. K. Gilbert.
The origin of crystalline rocks. T. Sterry Hunt.
On the photographs of the transit of Venus taken at the Lick observatory. Simon Newcomb.
Zoölogical results of the deep-sea dredging expedition of the U. S. Fish Commission steamer *Albatross*. A. E. Verrill.
The quantitative estimation of carbon in ordinary phosphorus. Ira Remsen.
Reduction of halogen derivatives of carbon compounds. Ira Remsen.
Reduction of barometric observations to sea level. Elias Loomis.
The study of comparative biography. C. S. Peirce.
Whether there is a minimum perceptible difference of sensation. C. S. Peirce and J. Jastrow.
The character of the heat radiated from the soil. S. P. Langley.
On the depth of the western part of the Atlantic ocean and Gulf of Mexico, with an exhibition of a relief model. J. E. Hilgard.
On the relative levels of the western part of the Atlantic ocean and Gulf of Mexico with respect to the Gulf Stream. J. E. Hilgard.
On the structure and affinities of Didymodus, a still living genus of sharks of the Carboniferous period. E. D. Cope.
On the North American species of Mastodon. E. D. Cope.
The characteristics of the Lyomerous Fishes. Theo. Gill and John A. Ryder.
On the classification of the apodal fishes. Theo. Gill and John A. Ryder (by invitation).
On the ichthyological peculiarities of the Bassalian realm. Theo. Gill.
On the fritts selenium cell. Geo. F. Barker.
On a lantern voltmeter. Geo. F. Barker.
On the occurrence of mercury in native silver from Lake Superior. Geo. J. Brush.
Progress in making a new photograph of the spectrum. H. A. Rowland.
On the existence of tin ore in the older rocks of the Blue Ridge. B. Silliman.
The Krakatoa atmospheric waves and the question of a connection between barometric pressure and atmospheric electricity. H. M. Paul (by invitation).
Memorandum on composite photographs in craniology. John S. Billings.
Some experiments upon the spectra of oxygen. A. W. Wright.

On the application of trinomial nomenclature to zoölogy. Elliott Coues.
Some recent results of the oral and aural teaching of the deaf under the continued system. E. M. Gallaudet (by invitation).
Jade implements from Alaska. F. W. Clarke.
Recent progress in electrical fuses. Henry L. Abbott.
The volcanic sand which fell at Unalashka, Oct. 20, 1883, and some considerations concerning its composition. J. S. Diller (by invitation).

Biographical memoirs of Gen. G. K. Warren, by Henry L. Abbott; of Professor Stephen Alexander, by L. A. Young; of Dr. J. Lawrence Smith, by B. Silliman, and of Dr. John L. LeConte, by S. H. Scudder, were read at an evening session of the academy.

Biological Society of Washington, April 5.—Communications by Dr. Leonhard Stejneger on the shedding of the claws in ptarmigan; by Mr. William H. Dall on the fishery exports of San Francisco in 1883; by Professor C. V. Riley on rusty oranges; Mr. F. A. Lucas exhibited a series of skulls of American Canidæ; Dr. D. E. Salmon remarked on the recent outbreak of the so-called "foot and throat disease" in the West; Dr. E. P. Howland on the effects of anæsthetics on the animal organization, with experiments and clinic on animals, showing the peculiar effects of the new anæsthetic, nitrous oxide and oxygen, administered in condensed air chambers.

April 19.—Communications by Dr. Cyrus Thomas on the growth of trees as a means of determining the age of mounds; by Mr. John Murdoch on dredging and marine collecting at Point Barrow; by Dr. Tarleton H. Bean on the distribution of the Salmonidæ in Alaska; Dr. R. W. Shufeldt, U.S.A., on the occurrence of a pair of free ribs on the occipital bone of the large-mouthed black bass, *Micropterus salmonides*, with specimen.

New York Academy of Sciences, April 7.—A paper on the hydraulics of the Mississippi from Cairo to the gulf was read by William L. Elseffer, C.E.

April 14.—The following paper was read: The uniformity of geological climate, by Professor Charles B. Warring.

April 28.—The following papers were read (in continuation of the subject presented on March 10): II. The "singing beaches of the Baltic; III. The sonorous sand-hills of Arabia and Afghanistan, by Professor H. Carrington Bolton.

Boston Society of Natural History, April 2.—Professor G. Fred. Wright spoke of the glacial dam at Cincinnati, and on the boundary of the glaciated area of Indiana; Professor Edw. S. Morse discussed the ancient and modern methods of arrow release.

April 16.—Dr. M. E. Wadsworth presented a paper on the relation of the "Keweenawan series" to the "Eastern sandstone" in the vicinity of Torch lake, Michigan.

APPALACHIAN MOUNTAIN CLUB, April 9.—A paper by Professor W. W. Bailey entitled, "Recollections of the West Humboldt mountains, Nevada," was read; Rev. Luther Farnham read a paper entitled, "Three Visits to the White mountains in 1837, 1862 and 1883;" Information was given concerning recent ascents in New Zealand among the Himalayas.

AMERICAN GEOGRAPHICAL SOCIETY, March 31.—Chief-Justice Daly, LL.D., delivered his annual address as president of the society, entitled recent developments in Central Africa and the valley of the Congo.

April 25.—General Jas. Grant Wilson delivered a lecture entitled memorials and footprints of Columbus, illustrated with stereopticon views.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Jan. 31.—Dr. Leidy exhibited some fossil bones from the salt mine of New Iberia, Louisiana, including remains of *Equus americanus* and two tibiæ of an adult Mylodon. A piece of matting had been found in association with mastodon teeth, but there was no evidence of their contemporaneity. Dr. Leidy stated that he had found, in specimens of drift from Central Minnesota, two species of foraminifera so closely resembling *Textularia globulosa* and *Rotalia globulosa* that no distinctive characters could be determined.

Feb. 2.—A paper by Miss Foulke, describing *Apsilus bipera*, was read. The author united Apsilus, Dictyophora and Cupelophorus under Apsilus. Professor Lewis announced the discovery of fossils in the Triassic red shale near Phœnixville, in a stratum probably 1000 feet below those previously discovered near that place. Five species of lamellibranchs, a fish and some plants were among the remains. The two species of Unio were regarded as probably the most ancient yet discovered. Professor Heilprin stated his belief that some of the Carboniferous bivalves which had been described under other names were true Unios.

Feb. 14.—Dr. McCook exhibited a drawing of the nest of the California spider, *Pucilia aurora*, which places its cocoons under flowers, and secures them by a maze of lines to the neighboring branches. The speaker also described the cocoons of *Segestria canites*, which are placed one above the other to the number of eight, and held in place by lines to the branches on each side of a pathway. A tube, the home of the spider, runs up one side of the suspended nests. The cocoons were frequently torn away by passing animals, but this simply aided distribution. An example of *Nephila plumipes* from the silk of which species Professor Wilder had woven small ribbons, was exhibited. Mr. Potts gave an account of the sponges found in the forebay of the Philadelphia water-works, and announced his belief that the sarcode of fresh-water sponges does not slough off at the approach of winter, and therefore that these organisms do not pollute the water. He believed that the whole of the sarcode retired into the statoblasts, from which it issued again in spring.